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Electrical World

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Electrical World

New York, Saturday, June 18, 1921

The American Business Man Voices an Opinion

NOT long ago the Chamber of Commerce of the United States made a survey of the business of the country. It endeavored to ascertain among other things what business men are doing to meet the conditions of the day. They were asked particularly as to their present policy respecting economy in advertising.

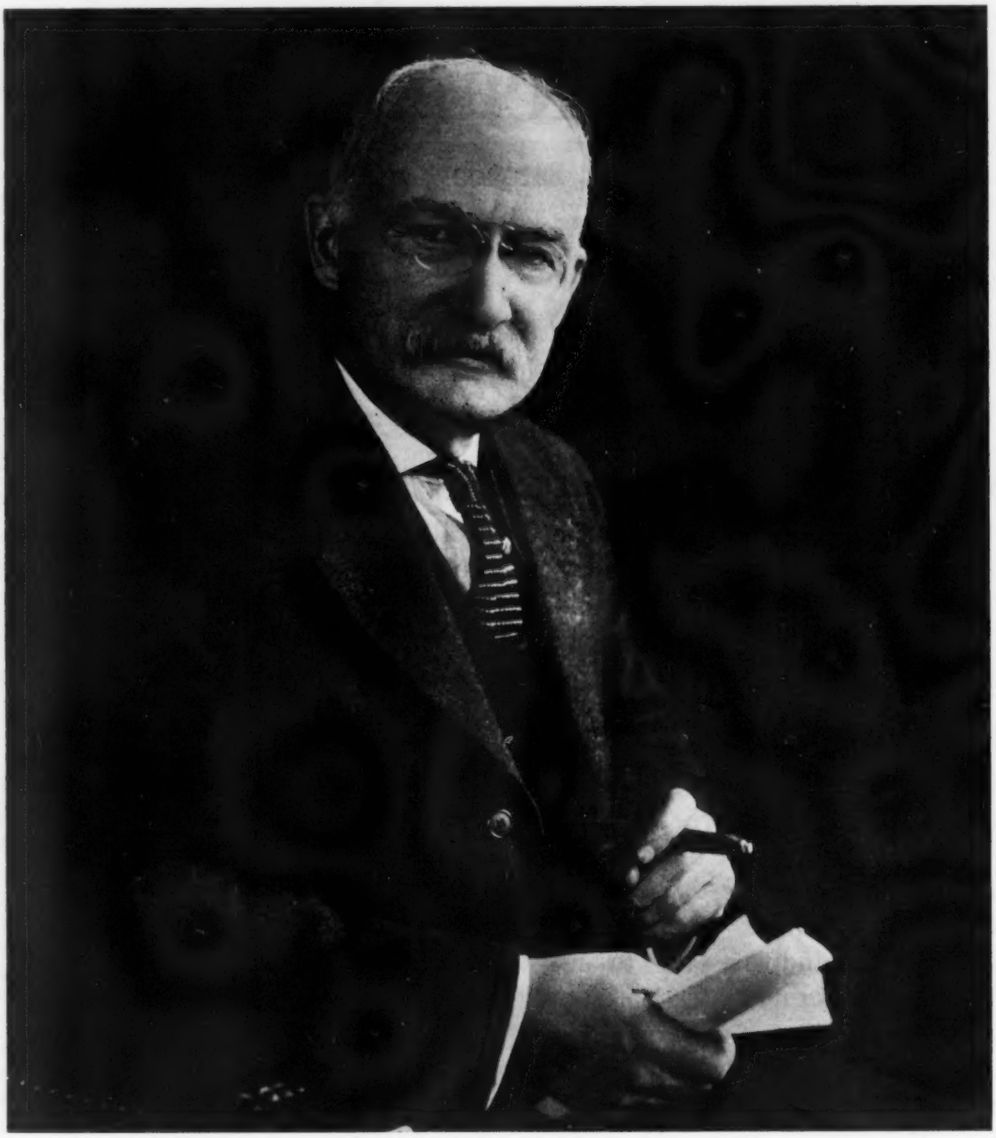
The only reason why there can be two opinions on the issue of whether or not to advertise at a time like this is because the true function of advertising is so beclouded in men's minds. Yet it is vital to the electrical industry and to every other industry right now. It is a matter of prime importance not alone to our manufacturers, but to our jobbers, central-station companies, contractors and dealers. Business is quiet. Demand is light. Earnings have fallen off. Should men spend money advertising?

There is a basic first point here that should be carefully disposed of in every man's thinking before he makes any decisions about advertising. That point is this: *What is advertising, anyway? What is it for?* The simple, ample answer is that advertising is just helping the salesman to sell more goods by telling his story in advance, saving his time, strengthening his influence and bringing in business for him. This being so, the question of whether or not to advertise becomes a question of whether or not to sell. For if a man wants business he must sell goods, and therefore he should advertise. The manner in which he should advertise and sell—this is the variable problem which must be settled to suit each business and the times.

The reaction to the inquiries of the Chamber of Commerce was convincing as to the attitude of the modern business man on this fundamental subject. These three brief quotations express it:

1. "We do not feel that we should decrease publicity. Our advertising expenditure should be increased to increase our business."
2. "Cutting down advertising would only increase the cost of selling merchandise, therefore we advertise heavily when business is hard to get and go easy when it is coming anyway."
3. "We kept our advertising appropriation down to bedrock when there was practically no sales resistance, conserving our funds for harder times. We feel that we now owe it to our distributers and dealers and to ourselves to insure a healthy flow of business by consistent, well-directed, forceful advertising."

Our national Chamber of Commerce has asked and the American business man has answered. It is advice for all of us. For now is a season when well-poised, full-bodied selling is needed in every industry, and no man's problem is too local or too small to be aided profitably by sensible advertising. He should give his salesmen this other voice to help them sell. They need it *now*.



Harry Bates Thayer

An executive whose perseverance, clear conception of responsibilities and ability to get things done have marked his career from office boy to the presidency of the world's largest public utility

THERE stands at the head of the world's largest public utility a man who by his own efforts and perseverance won his way up from office boy. H. B. Thayer, now president of the American Telephone & Telegraph Company, upon completion of his college course decided to start in at the bottom in some manufacturing industry of far-reaching scope. He began in 1881 with the Western Electric Company in Chicago, making out shipping tickets and indexing copy books and a little later making out bills. His work caught the attention of Enos Barton, founder and president of the company, and soon young Thayer became his assistant. At twenty-five, after three years with the company, Mr. Thayer was made manager of its New York branch. It was not long before he was doing more business in New York than was done at the parent factory. He was called back to Chicago as vice-president, and six years later, in 1908, was elected president.

When Mr. Vail came back in 1907 to take hold of the American Telephone & Telegraph Company, the parent company of the Western Electric, he chose Mr. Thayer as vice-president. However, in 1915, Mr. Thayer decided that he did not want to hold an active position in both companies and that his greatest value to the Bell Telephone interests was in the manufacturing end, so he gave himself wholly to the duties of the presidency of the Western Electric Company. The war came on and engulfed this country, and as an emergency measure the telephone service was taken over by the government. It became apparent, however, soon after the armistice that some reorganization of the telephone company was necessary to take over the business when the government should release it. Although Mr. Vail retained the control as chairman of the board he placed the executive management of the company in the hands of Mr. Thayer as president. Such is the bare story of achievement, but back of it are forty years of honest endeavor, initiative, application and the ability to get things done.

Mr. Thayer was born in Northfield, Vt., sixty-two years ago. At twenty-two he was graduated from Dartmouth. Since that time he has spent his life in the telephone industry, and thus he is a logical man to head this great business employing 270,000 people and so essential a part of the daily life of America. He took hold of the telephone at a critical time. During the federal control it was impossible to extend facilities to meet demand. As a result the system was returned to private control without the facilities for service and the public good will it had previously enjoyed. Since that time, in spite of high costs and wages, Mr. Thayer has never allowed the company to slacken in its efforts to bring the service once more up to that former high degree of efficiency known nowhere else in the world.

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Chicago Can Afford to Move Slowly

THE proposed ordinance regulating the sale, installation and use of electrical devices in the city of Chicago now under discussion before the City Council furnishes an example of one way that safety work cannot be effectively promoted. Designed ostensibly in the interests of public safety, but really as a revenue producer, the ordinance would place the future of the industry so far as Chicago is concerned in the hands of the Commissioner of Gas and Electricity and the political machine in power. If every city is to levy tribute on whatever is sold and used within its borders, manufacturers will have a glorious time of it. Nor is Chicago equipped properly to enforce the proposed ordinance. The city cannot by any stretch of imagination justify the establishment of a laboratory of sufficient size to test large turbo-generators, electric furnaces or a multitude of small devices not specifically covered by the various codes and standards already in operation. Chicago authorities will do well, therefore, to stop and think carefully before placing a burden on the electrical industry such as that made possible under the proposed ordinance. If the city is really desirous of reaching offenders against public safety, it should do so through an ordinance that cannot possibly be used as a club on the heads of the most deserving members of the industry. Even then it is a question whether Chicago can carry out such a task without the help of a national movement of the same character.

Perseverance in Co-operative Work

BECAUSE results do not always immediately come from the first steps taken in co-operative movements discouragement is likely to follow. This was the danger pointed out at the convention of the Pacific Coast Section of the National Electric Light Association held at Del Monte, Cal., last week, and an antidote was put forth in the form of stimulation of effort and earnestness. This message from the West to the electrical industry should receive careful attention, particularly from those guiding the first steps of the several groups now undertaking co-operative movements. Those voicing these warnings in the West have been through years of such work; they have passed through long periods of trial when it seemed as if they were doomed to almost certain failure; they have often met with little encouragement from the industry. It has been fortunate that the leaders there have shown unexcelled courage and steadfastness of purpose to continue until they have no longer been regarded as visionaries but as men of vision. Almost as obvious but not voiced so openly is the real need of guarding against complacency as the result of a measure of success. When after long trials success has at last been achieved it is the way of mankind to rest with smug satisfaction on the achievements of the past. Here is a temptation sedulously to be avoided, and so the message goes out from the Pacific Coast to the beginners in co-operation as well as to the veterans: If results are slow, keep pounding on; if results have come, forget them in greater efforts.

Politics Not Good for Utilities

AMONG the grievances, real or fancied, urged against utilities is the supposedly sinister influence exerted by them over municipal and state bodies by underground methods. One of the most important tasks of the campaign of education that the electric light and power industry is now conducting is to wipe out in the public mind the sting of that charge. If the task is to be accomplished, every contest must be fought in the open and won or lost on its merits. A battle won because some one can wield political influence is a battle lost in the establishment of the utilities in public confidence, because it will sooner or later be used to substantiate the charge that utilities are attempting unfairly to control governmental functions for selfish purposes. The underground political game carries a tremendous fascination for a certain type of mind. To play it is to play directly into the hands of the politicians who know it best and can stack the cards to win at every turn. Public utilities cannot afford to sit in such a game. We are moved to make this observation because in Oklahoma recently an engineer who traveled some distance to confer with the engineers of the commission was advised to lay his case before a utility attorney first because the latter would see that the engineer's recommendations were carried out. Such indirect methods are seldom efficacious and are always poor policy.

Sometimes Good Will Is Better than Efficiency

THE importance of the meter reader in making or breaking good will for his company is not always appreciated. Sometimes this functionary is the only representative of the company seen by a customer from one year's end to the other and the consumer's impressions of the lighting utility with which he is dealing are therefore due almost entirely to the man or boy who comes to read the meter. If he is brusque, unpleasantly insistent or in any way troublesome, ill will is sure to be created, and this usually overbalances any good will that may have been built up by long previous effort. The bonus system of paying for meter reading often tempts the reader to hurry in order to get a little more pay and thus actually works to the detriment of the

company. Hurried meter readings are liable to be tinged both with impoliteness and with inaccuracy. At such a cost efficiency in the total number of meters read in a day is dearly purchased.

An exactly opposite method is followed by the company mentioned in a former issue which picks out and pays exceptionally well a group of intelligent young men put on the meter-reading job for the special purpose of creating good will. Each man has plenty of time allowed him to cover his territory and is expected to keep within it except for good reason; but in particular he is instructed on his relations with the customers, is provided with blank complaint forms and authority to adjust small matters on the spot, and is made the active intermediary between the company and its consumers. Two years' experience showed that while meter-reading expense rose about 40 per cent on account of the better class of men employed, the adjustment bureau expense was cut down by one-half. Demands for special meter tests had almost disappeared and the general attitude of the public had been radically changed.

Adjustment and complaint service is, of course, necessary to any public utility, but large activities along this line should be anything but a source of pride. Costs transferred from settling complaints to promoting friendly contact with consumers are an asset instead of an expense.

Fuel Prices Necessitate Still Greater Economy

THE price of coal and oil seems likely to drive engineers away from their so-called standards toward greater economies than have ever before been considered feasible. An excellent example of this tendency as exemplified in the Calumet station of the Commonwealth Edison Company is briefly outlined in this issue. The plant will eventually contain six 12,000-volt generators, but at the present time two 30,000-kw. units are being installed—one a seven-stage impulse turbine and the other a tandem-compound Westinghouse turbine. Technically the most interesting feature of the plant is the boiler room. The plan calls for four boilers for each of the turbine units, but the two prime movers already installed will be served by seven. Each of the boilers contains a little more than 15,000 square feet of steaming surface, will evaporate 150,000 lb. of water per hour and is built for 350 lb. pressure at 250 deg. superheat. Two chain-grate stokers operated under forced draft will take care of the combustion for each boiler. Exceptionally large furnace space is employed and every facility for pushing combustion without serious loss of efficiency is provided. Each boiler is fitted with an economizer with steel tubes and headers, and indications are that by the use of these the total boiler efficiency will be pushed beyond 80 per cent of the theoretical limit. The character of the coal used, which is rather rich in sulphur, has necessitated some extra precautions, in particular pushing the temperature of the feed water to 175 deg. Fahr. before it enters the economizer to avoid any condensation of sulphurous gases on the economizer surface. All auxiliaries excepting the boiler-feed pumps are motor-driven, the larger auxiliary units being provided with 2,300-volt motors.

In this station the fuel costs are expected to account for about 86 per cent of the total operating expense, and it is believed that it will be possible to bring the station to a thermal basis of 19,000 B.t.u. per kilowatt-hour. This indicates how far the extreme measures taken will find justification in resulting economies.

Need of Looking Beyond the Meters When Errors Are Gross

GENERALLY speaking, the meter is an instrument of very fair degree of precision, much more likely to run slow than fast and not often committing serious errors of any kind. There are cases, however, in which through misconnection or gross misuse of some kind an electric meter performs badly, though it usually succeeds in punishing the central-station company more than it punishes anybody else. The importance of carefully following up the performance of meters is therefore emphasized, quite apart from its general desirability, by the need of looking out for the altogether abnormal performance sometimes noted.

Some striking examples of what may happen through the "boneheaded" (if that term may be permitted) use of what otherwise would have been an instrument of precision are given in the current issue by A. L. Johnston. "Mix-ups" in the wiring due to faulty installation are capable of almost any sort of enormity. One instance cited by Mr. Johnston is that of a meter which because it was badly proportioned to its work underregistered to such an extent that the station sustained a loss of about $10,000. Another interesting case which Mr. Johnston describes fully probably would not occur often, but the possibilities of wrong connections are always present, and it is worth while to see what may happen on occasion. All of this points to the moral that it is not sufficient to test meters in a perfunctory manner, because while the meter may appear to be accurate gross errors not due to the meter itself stand a chance of escaping detection.

The Virtues and Vices of American Manufacture

ONE of our foreign contemporaries has been making a study through a correspondent on this side of the water of recent tendencies in electrical manufacturing. The main tendencies that are summarized by this correspondent comprise a somewhat more vigorous exporting policy than has hitherto been displayed, an extraordinary activity in publicity work, more systematic standardization and more complete specialization, the development of planning and operating systems, the establishment of service departments for reaching the customers, and finally a strong development of research work. This summary, we think, is a very fair representation of electrical manufacturing tendencies in the United States. There is no doubt that we are seeking foreign markets, but if we are to capture them we must pursue in some respects policies contravening those now common. The foreigner looks at things in a somewhat more conservative fashion than we do, and sometimes objects to broad claims and meaningless trade-name designations unfamiliar to the consumer. Although the electrical industries have as a rule been conservative and judicious in their treatment of foreign markets, many manufacturers have attempted to sell goods abroad by the same methods which they adopt here and have failed dismally. The foreign trade is something which needs to be very carefully handled in every respect. The customs of South America, for instance, are not our customs, and we cannot force our

ways down South American throats. We must revise methods all along the line if we are to win and keep trade against the rising competition of Europe, and particularly of Germany, where the manufacturers for many years have wisely and consistently catered to the particular requirements of their foreign customers.

The same line of criticism applies to the complete standardization existing in America in many lines of work. Where deviations from our usual standards are for some reason required, the cost piled upon the customer is so enormous that the order frequently goes to a foreign competitor who is a little more flexible if not quite so efficient in his methods. Our tendency toward specialization in manufacture is a very healthy one provided that it does not tie itself up to standards so completely that it cannot readily change when a new demand arises.

Great improvements have been made in the last few years in the better planning and more systematic and efficient operation of works. However, it is not a difficult matter in following up the modern so-called efficiency methods to carry them to a point where they cost a great deal more than they save, making the whole organization topheavy and piling up overhead expenses which a less orderly competitor with a much simpler organization can in large measure avoid. Even system may be pushed too far.

Of the development of research work it is hard to speak in terms of too much praise. The present position of American manufacture, and particularly its rise in the last decade, is due very largely to the following up of a systematic policy of research. We would be even further ahead had that policy been carried out on a larger scale in earlier years. Our foreign competitors, too, have been for years ceaseless in research, and so far as can be ascertained they are not letting their activities slacken in the slightest degree. If we are to keep our present position in manufacturing, we must be equally persistent. The time of trial when we must match our wits against those equally clever, and perhaps more facile and flexible in their methods of attack, is clearly approaching.

Selecting Batteries for Electric Haulage

A VERY neat and simple analysis of the methods for adjusting battery capacity to demands of industrial locomotives, which in the last few years have come into greatly increased use, is presented in a brief paper by J. H. Tracy in the current issue. Starting with the grades and loads necessary to be dealt with, it is a fairly simple matter to calculate the tractive effort for each part of the proposed trip. When the total tractive effort per trip in whole or part has been found, it may be reduced to watt-hours per train mile for that particular section simply through multiplication by three. This step is one of the short cuts which providentially turn up now and then in the solution of engineering problems. The battery problem is handled most easily perhaps by reckoning on a six-hour discharge rate. Of course, for exceptionally high discharge rates at a particular section of the line allowance may have to be made in the simple ways which Mr. Tracy shows. The whole computation, however, will be found extremely convenient and easy to follow. It involves no recondite methods of any sort.

Aërial Cables Versus Open-Wire Lines

AËRIAL cables present possibilities that should appeal to central-station engineers, but the best means of realizing their proper application will come from a recognition of their limitations. Compared with an overhead open-wire line they will be more expensive, and they will always require relatively expensive joints to serve customers along the route. Furthermore, taps will make the handling of trouble very inadequate unless proper switches are provided at each one. Despite these limitations, however, there are many places where because of tree or building conditions, necessity of crossing railroad rights-of-way and so forth aërial cables are very advantageous. The manufacturer's design problem is one of producing a cheaper cable with the same reliability as that of an underground cable. This should be possible on account of the much better cooling obtained. Moreover, in order to decrease the stresses due to sleet and wind the cable should be made as small in diameter as possible, and for ease in handling it should be made as light as possible.

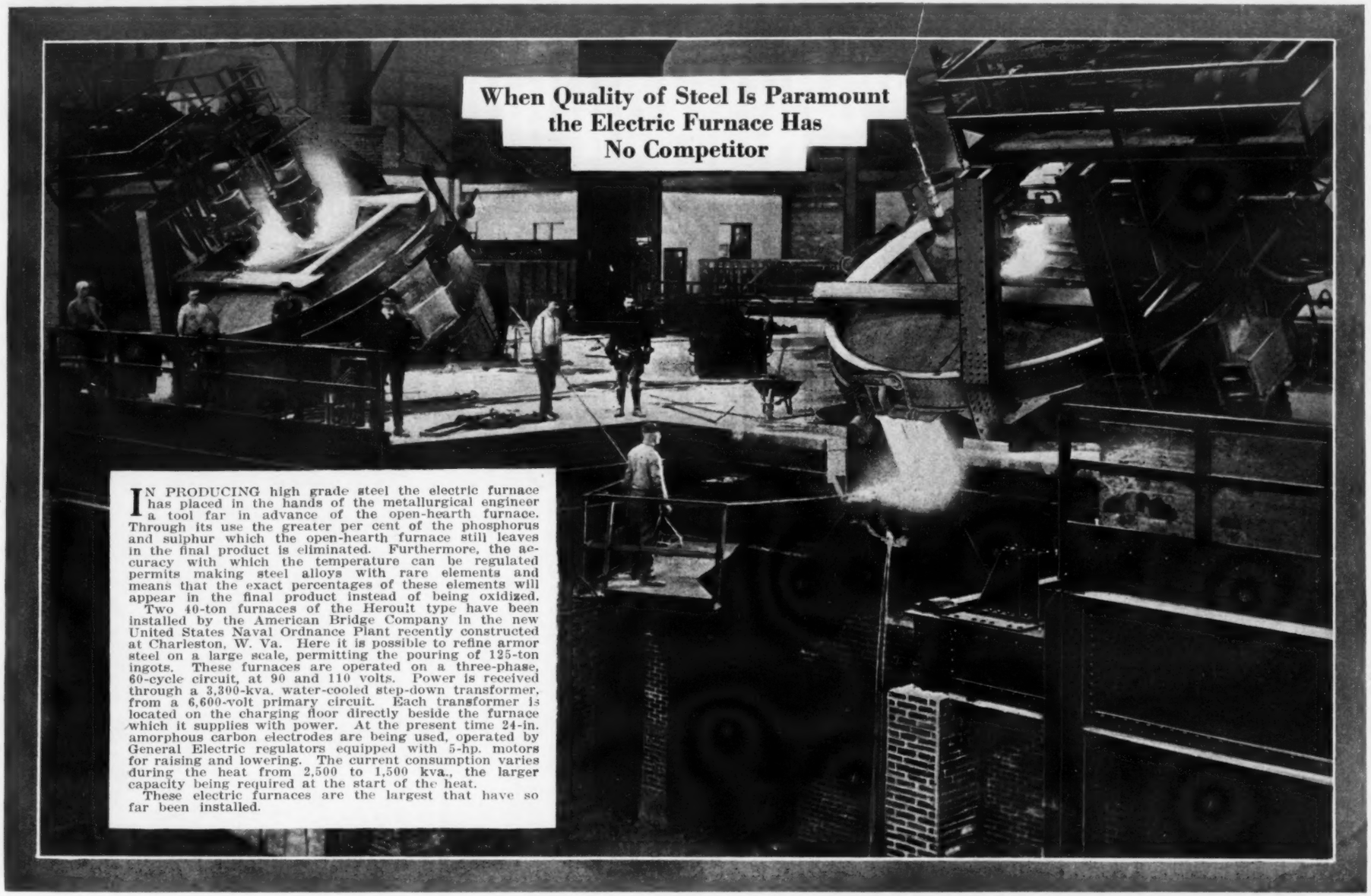
The article in the current issue by F. A. Westbrook should be of interest to our readers because it brings out in a concise manner the position that aërial cables should hold in the central-station system. The tables furnished should be particularly useful, for they enable anybody to compare the merits of the various kinds of cable that can now be purchased, and the data given should tend toward developing the application of aërial cables.

Maximum Demand a Necessary Factor in Rates

PROOF comes every day that rates for electrical energy based on maximum demand and total kilowatt-hours delivered are an economic necessity. Though this method of charging for central-station service is very common, there are still many who have not adopted it. Many of the details of the method may not have been sufficiently worked out owing to the magnitude of the task of determining the effects on a system of all different types of load and the actual cost to the company of furnishing each kind of service; but it is still generally accepted that the solution of the rate problem must be based on the fundamental principle involved in maximum-demand rates.

All those electric light and power companies which are still limiting their power contracts to a single kilowatt-hour charge, and which, realizing the shortcomings of their methods, still are unwilling to risk the change, should be interested in reading W. W. Arnett's short article in the ELECTRICAL WORLD of May 21 on "Tables for Estimating Customers' Maximum Demand." There they will find an exposition of the imperative necessity for the application of a rate based on maximum demand and total kilowatt-hours delivered, and beyond that an account of how one central-station company was able to make the change without delay. Facing the impossibility of obtaining and installing demand meters in a short period of time, it was found necessary to resort to some other method of putting the rate into effect. Mr. Arnett's conclusions show that maximum demand can be estimated with sufficient accuracy to satisfy both the customer and the producer during the interval required for the installation of demand meters.

When Quality of Steel Is Paramount the Electric Furnace Has No Competitor



IN PRODUCING high grade steel the electric furnace has placed in the hands of the metallurgical engineer a tool far in advance of the open-hearth furnace. Through its use the greater per cent of the phosphorus and sulphur which the open-hearth furnace still leaves in the final product is eliminated. Furthermore, the accuracy with which the temperature can be regulated permits making steel alloys with rare elements and means that the exact percentages of these elements will appear in the final product instead of being oxidized.

Two 40-ton furnaces of the Heroult type have been installed by the American Bridge Company in the new United States Naval Ordnance Plant recently constructed at Charleston, W. Va. Here it is possible to refine armor steel on a large scale, permitting the pouring of 125-ton ingots. These furnaces are operated on a three-phase, 60-cycle circuit, at 90 and 110 volts. Power is received through a 3,300-kva. water-cooled step-down transformer, from a 6,600-volt primary circuit. Each transformer is located on the charging floor directly beside the furnace which it supplies with power. At the present time 24-in. amorphous carbon electrodes are being used, operated by General Electric regulators equipped with 5-hp. motors for raising and lowering. The current consumption varies during the heat from 2,500 to 1,500 kva., the larger capacity being required at the start of the heat.

These electric furnaces are the largest that have so far been installed.

Power Distribution Over Aërial Cables

Construction of This Kind Appears to Have Many Advantages Over Open Wires—Lead-Covered, Paper-Insulated Cables, Particularly, Are Advocated—Experience of Telephone Companies Indicates that Lead-Covered Aërial Cables Are Reliable

By F. A. WESTBROOK
Field Engineer Habirshaw Electric Cable Company

PROBABLY the most economical method of meeting the demands imposed upon distribution systems of central-station companies by the extensive electrification of industry now going on is to supply energy at higher voltages. This, however, raises serious construction problems, such as whether open-wire construction is practicable under the circumstances, whether the expense of underground cable is warranted, or whether some other method is preferable. There is a growing tendency on the part of a good many companies to meet the situation by the use of aërial multiple conductor cables, supported by messenger cables, for high-voltage distribution and transmission within municipal limits. Long experience of the telephone companies with aërial cables indicates that lead-covered, paper-insulated cables are amply rugged and reliable to warrant their use by power companies on pole lines. Up to the present time, however, the use of aërial cables has not been developed to the extent which the advantages of this practice would seem to warrant, and a discussion of different types of cables, together with data as to their weights under actual conditions of service, should be timely.

ADVANTAGES OF AËRIAL CABLES ARE SUMMARIZED

The advantages of using insulated cables as compared with ordinary open-wire and cross-arm construction are briefly as follows:

1. In many cases municipal park authorities or shade-tree commissions have restricted tree trimming in residential sections, thus rendering open-wire construction impracticable.

2. Cable construction is advantageous where pole lines are too congested for additional circuits without providing taller poles.

3. Cables give greater assurance of continuity of service. They would remain in operation even when the poles are broken off and they are lying on the ground, provided that the cable itself is not seriously injured. The conditions approximate the advantages of underground construction at greatly reduced annual charges.

4. There is a reduction of hazard from the falling of high-tension wires in public places because of mechanical or electrical failure of the line.

5. Where a pole line carries several three-phase open-wire circuits of small-size wires which have been added from time to time as the load increased, the circuits may frequently be advantageously combined into one large-size three-conductor cable, perhaps at increased voltage. The cable, on account of being placed low on the poles, will reduce the stresses on the poles as well as make space available for other wires.

6. The question of substituting 6,600-volt primary distribution in place of 2,300-volt distribution, which is receiving considerable attention at the present time and is actually being carried out in some instances, would in many cases be greatly simplified by the use of cable for the 6,600-volt circuits. The expense of reconstructing 2,300-volt lines for the higher voltage can in many cases be substantially reduced in this way, especially where tree conditions are bad. In fact, bad tree conditions may make the increases in voltage dependent on the use of aërial cable.

7. The use of cables instead of open wires for circuits at transmission voltages should greatly simplify the question of conflicts with telephone lines on the same street or highway, on account of the reduced danger of accidental contact between the two systems.

In considering the question of attaching a cable to a line of poles the three following items must be taken into account:

(a) Ability of the poles to carry the cable weight.
(b) Protection against moisture.
(c) Protection against mechanical injury.

The lack of full knowledge as to the loads involved in attaching cables to poles, as well as the question of the most advantageous design for such cable, has so far resulted in greatly restricting the use of aërial power cable construction.

While reasonably substantial pole-line construction is required, it is felt that these requirements are generally greatly overestimated and that except where very large cables are involved the problem is no more serious than that incurred in the every-day practice of the telephone companies with similar construction. In many cases aërial power cables suspended from a messenger cable involve a much smaller load on the poles than a line with two or three cross-arms carrying open wires, especially under severe sleet and wind conditions.

As paper-insulated cable is the best type, especially for the transmission voltages, on account of its lower dielectric losses, higher current-carrying capacity and lower cost, the question of protection against moisture is particularly important. A lead sheath is undoubtedly the best protection.

There seems to be a feeling that power cables should be protected mechanically with steel-tape armor rather than by a lead sheath. The experience of the telephone companies, however, has indicated that there is no necessity for more than a lead covering from the standpoint of mechanical protection when the lead sheath is of adequate thickness for the size of cable used.

AËRIAL CABLES DO NOT IMPOSE EXCESSIVE LOADS UPON POLES

In order to determine what loads actually have to be supported by poles under service conditions, the resultant loading of various sizes of three different types of cables has been calculated, assuming the ½-in. (1.27-cm.) radial thickness of ice on cable and messenger, with the wind pressure of 8 lb. per square foot (39 kg. per sq.m.) on the ice-covered projected area of the cable and messenger, as prescribed for the

TABLE I—COMPARISON OF LOADS IMPOSED BY AËRIAL CABLES

Size, A.W.G.	Volts	Type No. 1* ⅛-In. Lead Sheath, Belt Insulation. Same as Conductor Insulation: Diameter, In.	Weight of Cable, Lb. per Foot	Resultant Load, Including Messenger† Lb./Ft.	Type No. 2* ⅛-In. Lead Sheath, Belt Insulation. Half Conductor Insulation: Diameter, In.	Weight of Cable, Lb./Ft.	Resultant Load, Including Messenger,† Lb./Ft.	Type No. 3 Reinforced Rubber: Diameter, In.	Weight of Cable, Lb./Ft.	Resultant Load, Including Messenger,† Lb./Ft.	Reduction in Loading of: Type No. 3 Over Type No. 1, per Cent	Type No. 3 Over Type No. 2, per Cent
4	6,600	1.54	3.85	6.73	1.41	3.43	6.25	1.78	2.49	5.64	16.2	9.8
2	6,600	1.67	4.45	7.33	1.54	4.09	7.00	1.91	2.94	6.19	15.6	11.5
1	6,600	1.75	4.86	7.63	1.63	4.48	7.43	1.99	3.27	6.54	14.3	12.0
0	6,600	1.84	5.33	8.32	1.72	4.93	7.95	2.08	3.63	6.95	16.5	12.5
2/0	6,600	1.75	5.34	8.26	1.61	4.91	7.84	1.99	3.79	7.02	15.0	10.5
3/0	6 600	1.83	5.94	8.90	1.71	5.50	8.20	2.07	4.27	7.54	15.3	8.1
4/0	6,600	1.93	6.57	9.58	1.80	6.19	9.23	2.21	4.93	8.28	13.6	10.2
250,000	6,600	2.07	7.39	10.49	1.95	6.92	10.06	2.47	6.49	10.05	4.2	....
4	13,500	1.94	5.20	8.25	1.75	4.57	7.61	2.06	3.11	6.38	22.7	14.9
2	13,500	2.06	5.82	8.95	1.87	5.21	8.33	2.22	3.71	7.14	20.2	14.3
1	13,500	2.14	6.25	9.40	1.96	5.65	8.84	2.41	4.89	8.42	10.4	4.8
0	13,500	2.24	6.78	10.00	2.05	6.14	9.35	2.51	5.36	8.93	10.7	4.5
2/0	13,500	2.14	6.77	9.95	1.95	6.20	9.34	2.41	5.38	8.88	10.8	4.9
3/0	13,500	2.23	7.40	10.62	2.04	6.67	9.87	2.50	5.99	9.52	10.4	3.6
4/0	13,500	2.32	8.08	11.35	2.13	7.39	10.63	2.59	6.53	10.12	10.8	4.8
250,000	13,500	2.47	8.92	12.31	2.28	8.13	11.58	2.74	7.28	10.97	10.9	5.2
4	25,000	2.53	7.47	10.9	2.24	6.42	9.76	2.80	5.80	9.58	12.1	2.0
2	25,000	2.65	8.17	11.33	2.37	7.10	10.55	2.92	6.50	10.34	8.7	2.0
1	25,000	2.73	8.67	12.10	2.46	7.44	10.94	3.00	6.89	10.80	10.7	1.3
0	25,000	2.83	9.12	12.7	2.55	8.13	11.67	3.10	7.20	11.18	12.0	4.2
2/0	25,000	2.73	8.56	12.12	2.44	7.95	11.43	3.00	6.74	10.63	12.3	7.0
3/0	25,000	2.81	9.85	13.42	2.54	8.61	12.12	3.08	7.93	11.85	11.7	2.2
4/0	25,000	2.91	10.59	14.21	2.63	9.41	12.99	3.18	8.71	12.70	10.6	2.2
250,000	25,000	3.05	11.50	15.21	2.78	10.13	13.77	3.32	9.47	13.52	11.1	1.8

* Insulation thicknesses have been assumed as follows: Type No. 1: 6,600 volts, 8/64-in. x 8/64-in. belt; 13,500 volts, 12/64-in. x 12/64-in. belt; 25,000 volts, 18/64-in. x 18/64-in. belt. Type No. 2: 6,600 volts, 8/64-in. x 4/64-in. belt; 13,500 volts and 12/64-in. x 6/64-in. belt; 25,000 volts, 18/64-in. x 18/64-in. belt.
† 16,900-lb. messenger cable has been assumed for all cables.

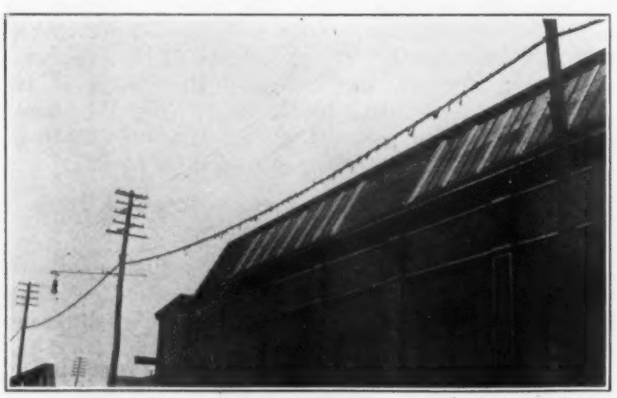
"heavy loading district" in the National Electrical Safety Code. Resultant loads in pounds per linear foot of cable imposed upon the pole are given in Table I. The three types of cable considered are all three-conductor, paper-insulated. No. 00 A.W.G. and larger are sector cables. Construction is as follows:

1. Outside covering consisting of ⅛-in. (3.2-mm.) lead sheath with belt insulation of same thickness as insulation around each conductor.

2. Outside covering consisting of ⅛-in. lead sheath and belt insulation one-half thickness of insulation around each conductor.

3. With a portion of the paper belt replaced with reinforced rubber covered with saturated braid, steel-tape armor and asphalted jute.

Cables of the first and second types are well known and require no comment. The third type has reinforced rubber, saturated braid, steel-tape armor and asphalted jute in place of a lead sheath. Considered alone, it is much lighter than type No. 1, but the diameter is so much greater that the sleet and wind load largely counterbalance this. (See Table I.)



WEATHER HAS AFFECTED CABLE WITH JUTE COVERING OVER ARMOR

It is now preferred to omit the jute and protect the steel armor by painting.

Cables approximating type No. 1 are much more commonly used than cables strictly of this type. It is to be noted that with type No. 2 the reduction of belt thickness has a greater proportional effect with lead-covered cables than would be the case with type No. 3 on account of lead having a higher specific gravity than the outer coverings of steel-tape armored cable. Such a reduction will, of course, make possible the use of larger cables from the standpoint of both conductors and voltage without exceeding the weight of telephone cables as shown in Table II.

The saving in weight obtained in using aërial cable of type No. 3 construction instead of type No. 1 construction amounts to 50 per cent, as shown by the figures given in Table I, where only the weight of the cable is considered. But where the wind and sleet loading are taken into account it will be seen that the saving is on the average only from 10 to 20 per cent over type No. 1, due to the larger diameter of type No. 3 cable. It would seem, moreover, that a thorough consideration of this matter requires that the sleet and wind loading be taken into account as prescribed by the National Electrical Safety Code.

In order to reduce the figures in Table I to a readily comprehensible standard of actual practice, comparison is made in Table II between the resultant loadings of the three types of various sizes of power cables and of aërial telephone cables. They are grouped in sets of approximately the same resultant loading. From this it will be seen that common sizes of paper-insulated, three-conductor cable, type No. 1 or No. 2, do not require any heavier pole-line construction than is required for standard telephone cables.

It will be noted by reference to Table I that for small cables in which the resultant loading is unimportant the reinforced rubber type has the advantage, whereas for large cables the difference is negligible.

It is interesting to bear in mind in this connection

that some of the telephone trunk lines, in addition to carrying the largest size of lead-covered cables, also frequently carry three or four cross-arms of ten wires each, the combined resultant loading of which under the most adverse conditions would greatly exceed the weight of a 250,000-circ.mil, 25,000-volt power cable of type No. 1 construction.

In fact, telephone engineers have reached the conclusion that the factors of safety of the poles used for aërial cable construction at the present time are ordinarily much greater than necessary, and in the future they expect to use class B or C poles where they formerly used class A poles. The very heaviest lead-covered underground power cables could readily be supported on poles where the sections are not very long so far as strength of the latter is concerned. Stronger fittings of this kind can easily be developed as occasion demands.

It is felt that lead-covered power cable can be most advantageously used wherever the weight does not exceed the maximum encountered in telephone construction. Telephone practice has been thoroughly justified over a long period of time and wide range of territory. The reasons for this conclusion are:

1. Among the advantages of having paper insulation are the use of a standard product and the high carrying capacity of paper insulation.

2. The use of paper insulation calls for an effective outer weatherproof covering which can only be secured either by rubber in some form or by lead sheathing, and the latter eliminates the necessity of steel-tape armor, which has to be painted frequently to preserve it. Where steel-tape armor is protected from corrosion with asphalted jute, the latter rots after a few years and hangs down in a very unsightly manner.

3. The advantage of having aërial and underground cables practically similar in construction and eliminating special and more or less complicated types of cable.

4. Moisture-proof splices are more surely obtained.

5. Paper-insulated, lead-covered cable is the least expensive which can be used for this service.

AËRIAL POWER CABLE PASSING THROUGH HEAVY SHADE TREES

6. Smaller diameter of cable is obtained by using a lead sheath than with steel-tape armor with jute, resulting in lower sleet and wind loading.

7. Lead-covered cable can be more easily pulled through rings attached to the supporting messenger cable than steel-tape armored cable.

The fear has been expressed by some engineers that lead-covered aërial cables would be subject to deterioration of the lead sheath as the result of crystallization due to vibration. It has been found that when the lead sheath consists of commercially pure lead deterioration does take place, but a small amount of tin or antimony eliminates this difficulty.

TABLE II—COMPARISON OF RESULTANT LOADINGS OF TELEPHONE AND POWER CABLES

W = weights in pounds per foot, with ice, wind load and supporting messenger cable

Telephone Cables		Power Cables								
		Type No. 1 Lead			Type No. 2 Lead			Reinforced Rubber		
Pairs of No. 19	*W*	Size	Voltage	*W*	Size	Voltage	*W*	Size	Voltage	*W*
101	6.54	No. 4	6,600	6.73	No. 4	6,600	6.25	No. 4	6,600	5.64
					No. 2	6,600	7.00	No. 2	6,600	6.19
								No. 1	6,600	6.54
								No. 0	6,600	6.95
								No. 00	6,600	7.02
								No. 4	13,500	6.38
								No. 2	13,500	7.14
152	7.88	No. 2	6,600	7.33	No. 1	6,600	7.43	No. 000	6,600	7.54
		No. 1	6,600	7.63	No. 0	6,600	7.95	No. 0000	6,600	8.28
		No. 0	6,600	8.32	No. 00	6,600	7.84			
		No. 00	6,600	8.26	No. 000	6,600	8.20			
		No. 4	13,500	8.25	No. 4	13,500	7.61	No. 1	13,500	8.42
					No. 2	13,500	8.33			
202	8.95	No. 000	6,600	8.90	No. 4/0	6,600	9.23			
		0000	6,600	9.58						
		2	13,500	8.95	1	13,500	8.84	No. 0	13,500	8.93
		1	13,500	9.40	0	13,500	9.35	00	13,500	8.88
		0	13,500	10.00	00	13,500	9.34	000	13,500	9.52
		00	13,500	9.95	000	13,500	9.87			
					4	25,000	9.76	4	25,000	9.58
303	10.93	250,000	6,600	10.49	250,000	6,600	10.06	250,000	6,600	10.05
		No. 000	13,500	10.62	4/0	13,500	10.63	4/0	13,500	10.12
		0000	13,500	11.35	250,000	13,500	11.58	250,000	13,500	10.94
		No. 4	25,000	10.90	No. 2	25,000	10.55	No. 2	25,000	10.34
		2	25,000	11.33	1	25,000	10.94	1	25,000	10.80
					0	25,000	11.67	0	25,000	11.18
					00	25,000	11.43	00	25,000	10.63
								000	25,000	11.85

The experience of a number of power and lighting companies as well as telephone and telegraph companies with lead-covered aërial cables may be summed up about as follows:

1. Failure due to crystallization are negligible.

2. If failure occurs, it is always at the poles, where it is easily located and repaired.

3. Long spans, especially those exceeding 140 ft. (43 m.), are conducive to this trouble, but where the pole sections are only about 100 ft. (30 m.) this is not serious. In the urban districts, where aërial power cables are likely to be used, the spans are usually short.

4. The stiffer a cable, the less the liability of trouble.

5. It is important that the cables be run past poles without bending of any kind so that the contraction and expansion due to temperature changes will not cause cracks.

6. Cutting of the lead sheath by supporting rings can be eliminated by placing a saddle of lead between ring and sheath at two rings each side of the pole, or by using marlin hangers. Sometimes a marlin wrapping is used around the cable where it touches the pole, to prevent chafing.

7. Before tin or antimony was used with the lead considerable trouble was incurred.

8. Many of the largest cables have been in use from ten to fifteen years without any kind of trouble. The result of the telephone companies' experience is such that they do not feel it necessary even to consider a substitute for lead sheaths.

9. Power cables larger than the largest telephone cables may perfectly well be used by adopting easily developed modifications of the ordinary methods of suspension, such as catenary reinforcing cables, etc. Ordinary class B poles in good condition will support almost any cable which could be used provided that the pole sections do not exceed about 100 ft. (30 m.).

The experience of a few of the power companies that have lead-covered power cables follows:

1. The New York & Queens County Railway Company has a cable about 3 miles (4.8 km.) long which has been in service several years without breakdown.

2. The New York & Queens Electric Light & Power Company has a cable approximately 3 miles in length which has been in service about four years without developing trouble.

3. The Yonkers Lighting Company has, in addition to other types, a small amount of lead-covered aërial cable installed during the war period which has proved entirely satisfactory.

4. The Public Service Electric Company of New Jersey has about 8 miles (13 km.) of lead-covered aërial cable in addition to the reinforced rubber-covered cable. The lead-covered cable has been in service for more than ten years without ever having had a breakdown.

5. The Elmira Water, Light & Railway Company has two lead-covered aërial cables, totaling 3 miles in length, which have been in service for ten and four years respectively without serious trouble. Some troubles would undoubtedly have been avoided if the cables had been run straight past holes and if tin or antimony had been used in the sheath.

6. The Central Hudson Gas & Electric Company has about a mile of cable at Cornwall, N. Y., installed in 1916, which to date has not developed trouble of any kind.

Water-Power Applications Total 14,547,476 Hp.

Federal Power Commission Reports the Receipt of 222 Applications for Preliminary Permits and Licenses Up to and Including June 4

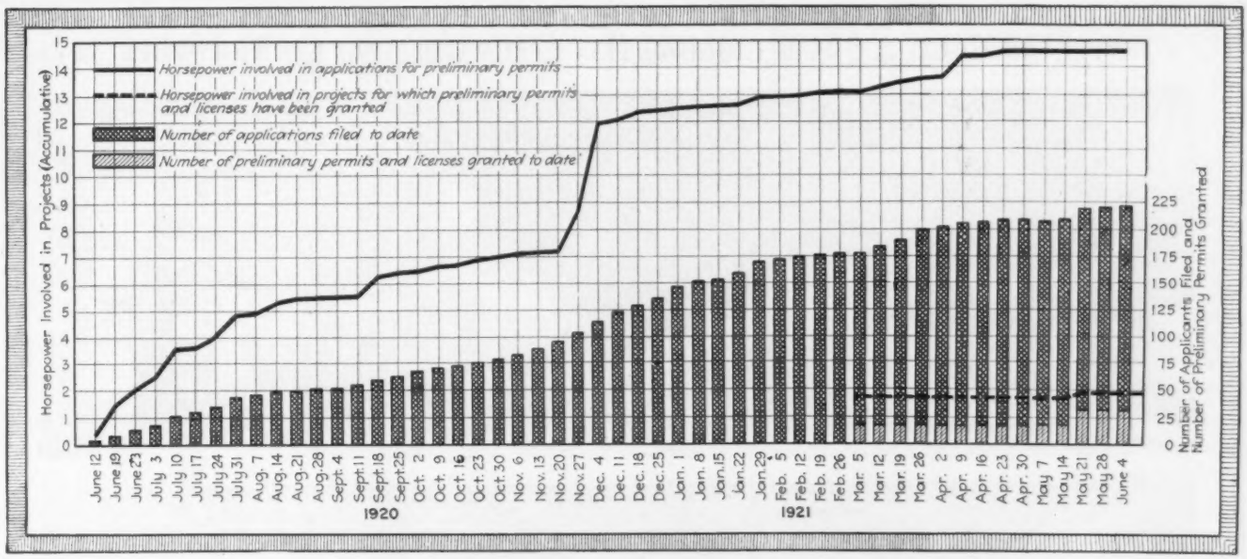
TWENTY-TWO permits were filed with the Federal Power Commission during April and May, involving a total of 1,300,645 hp. The latest data issued by the commission indicates that the net capacity of the 222 projects now on file totals 14,547,476 hp.

The applications filed since February indicate that the larger projects were included in applications filed prior to that date or that the later projects conflicted to a large extent with prior filings. The applications filed subsequent to February involve an average of only 31,753 hp., while those filed up to and including February involved a total of 73,878 hp.

With the exception of a small project on the Muskingum River in Ohio, the eastern portion of the coun-

TABLE I—LOCATION AND SIZE OF WATER-POWER PROJECTS FOR WHICH APPLICATIONS FOR PRELIMINARY PERMITS WERE FILED WITH THE FEDERAL POWER COMMISSION FROM MARCH 26, 1921, TO AND THROUGH JUNE 4, 1921.

Name of Company	Location of Project	Capacity, Hp.
ALASKA:		
Town of Petersburg, Petersburg, Alaska	Crystal Lake on Mitkoff Island	2,500
George Inlet Packing Co., Peninsula National Bank Bldg., Portland, Ore.	Beaver Falls Creek, 12 miles from Ketchikan	100
Hirst Chicagof Mining Co., 316 First Ave., South Seattle, Wash.	Small lake at head of Didrickson Bay, Chicagof Island	360
J. H. Cann, Box 281, Juneau, Alaska	Cann Creek at head of Lisianski Inlet, Alaska	75
Saw Tooth Power Co., care F. B. Colton, 256 Broadway, New York City	Pass Creek and tributary streams, Kongarok Precinct, Seward Peninsula	40,000
ARKANSAS:		
Dixie Power Co., Title Guaranty Bldg., St. Louis, Mo.	North Fork White River in Baxter County	.....
CALIFORNIA:		
E. B. Walthal, 1860 Van Ness Ave., Fresno, Cal.	Middle and South Forks of Kings River	125,000
City of Los Angeles, Dept. of Public Service, 603 Knickerbocker Bldg., Los Angeles, Cal.	Two power installations in San Francisquito Canyon in connection with Los Angeles Owens River Project	70,000
Yosemite Power Co., Groveland, Cal.	South Fork of Tuolumne River.	9,000
Original Mining & Milling Co., Merced, Cal.	Merced River, Mariposa County	500
Ed. Fletcher, 920 Eighth St., San Diego, Cal.	Boulder Creek, San Diego County	.....
Luther O. Griffith, Oroville, Cal.	Middle Fork of Feather River	1,700
COLORADO:		
Thomas P. Mitchell, Ouray, Col.	Transmission line	.....
IDAHO:		
Grangeville Electric Light & Power Project, Grangeville, Idaho.	South Fork Clearwater River	960
OHIO:		
Harry W. Depreso, Shelbyville, Ind.	U. S. Government Dam No. 5 on the Muskingum River	550
OREGON:		
California Oregon Power Co., San Francisco, Cal.	Klamath River	94,000
UTAH:		
Green River Power Co., Pacific Electric Bldg., Los Angeles, Cal.	Green River, from point near Green River, Wyo., to its junction with Grand River, Utah	912,600
WASHINGTON:		
Kelly Mines Co., 1213 L. C. Smith Bldg., Seattle, Wash.	Fishhook Creek and Little Susitna River	3,000
Royal Development Co., care James Naughten, Wenatchee, Wash.	Dry, Chipmunk and Phelps Creeks	200
Lewis River Hydro-Electric Power Co., 704½ Main Street, Vancouver, Wash.	Lewis River in Clarke, Skamania and Cowlitz Counties	20,000
WYOMING:		
Colowyo Gold Mining Co., Centennial, Wyo.	Middle Fork of Little Laramie River	100
John T. Clarke, Room 314, 503 Fifth Ave., New York City	Big Horn River, Fremont County	20,000


Horsepower involved in applications for preliminary permits
Horsepower involved in projects for which preliminary permits and licenses have been granted
Number of applications filed to date
Number of preliminary permits and licenses granted to date
Horsepower Involved in Projects (Accumulative)
Number of Applicants Filed and Number of Preliminary Permits Granted
1920
1921

GROWTH IN NUMBER OF APPLICATIONS FILED AND GRANTED AND HORSEPOWER INVOLVED

try is not represented in the applications filed during April and May. Five of the projects are in Alaska, six in California, three in Washington, two in Wyoming and one each in Utah, Idaho, Ohio, Arkansas and Oregon. One application for preliminary license was filed for a transmission line to be located in Colorado. The largest project recorded during these two months was that of the Green River Power Company, involving a comprehensive scheme to develop all the water powers in the Green River from a point near Green River, Wyo., to its junction with Grand River in Utah. A total of 912,000 hp. is involved in this project. Another proposed large development is that of E. B. Walthal, on the forks of Kings River in California, which involves a total of 125,000 hp. Both of these applications are in conflict to some extent with prior applications.

Table I gives the location and size of water-power projects for which applications for preliminary permits and licenses were filed with the Federal Power Commission from March 26 to and through June 4, 1921. The list of applications filed prior to March 26 appeared in the ELECTRICAL WORLD of Jan. 1, Jan. 15, Feb. 12, March 12 and April 9.

Twelve applications for preliminary permits and licenses were granted by the commission during April and May. Table II gives the location and size of these projects. Applications granted prior to April were noted in the April 9, 1921, issue of ELECTRICAL WORLD.

Twenty-nine applications for preliminary permits have been granted by the commission involving a total of 1,980,746 hp. This is only about 14 per cent of the total horsepower involved in the 222 applications now on file. These applications granted are for projects located in seventeen different states, California leading the list with eight projects, followed by New York with four. The largest project for which a preliminary permit has been granted by the Federal Power Commission is that of the Southern California Edison Company for a project on the South Fork of the San Joaquin River in Fresno County, California, and involving an ultimate development of 425,000 hp. This is followed by the project of the Niagara Falls Power Company at Niagara Falls, involving an ultimate development of 400,000 hp. Three other large developments for which preliminary permits have been granted are those of the Washington Irrigation & Development Company, involving 300,000 hp.; the Lower Niagara River Power & Supply Company's project, involving 250,000 hp., and the project of the Southern California Edison Company in Big Creek, California, involving 120,000 hp. The eight projects in California for which preliminary permits have been issued involve a total of almost 680,000 hp.

TABLE II—LOCATION AND SIZE OF WATER-POWER PROJECTS FOR WHICH PRELIMINARY PERMITS OR LICENSES HAVE BEEN GRANTED BY THE FEDERAL POWER COMMISSION FROM MARCH 26, 1921, TO AND THROUGH JUNE 4, 1921

Name of Company	Location of Project	Capacity, Hp.
ALABAMA:		
Alabama Power Co., Birmingham, Ala.	Coosa River	30,000
ARIZONA		
James B. Girand, Dave Parsons, Klapp, Brinckerhoff & Douglas, 84 Pine St., New York City	Colorado River near Diamond Creek	60,000
CALIFORNIA:		
Merced Irrigation District, Merced, Cal.	Merced River at Exchequer	40,000
C. B. Johnson, care V. G. Preston, Bishop, Cal.	Transmission line	.....
COLORADO:		
Thomas P. Mitchell, Ouray, Col.	Transmission line	.....
IDAHO:		
John R. Love, care V. G. Preston, Bishop, Cal.	Salmon River, Custer County	400
Utah Power & Light Co., care M. O. Leighton, National Savings and Trust Bldg., Washington, D. C.	Soda Point, Lava, Narrows and Mink Projects, Bear River	21,500
ILLINOIS:		
State of Illinois, care the Governor, Springfield, Ill.	Desplaines and Illinois Rivers	40,000
NORTH CAROLINA:		
Granite Falls Manufacturing Co., Granite Falls, N. C.	Wilson Creek, Caldwell County	2,000
UTAH		
Great Basin Power Co., Walker Bank Bldg., Salt Lake City, Utah	North Fork Duchesne River	25,000
VIRGINIA:		
Roanoke River Development Co., 318 Mutual Bldg., Richmond, Va.	Roanoke, Va.	60,000
WYOMING:		
Home Colony, care L. R. Ewart, Cody, Wyo.	Kitty Creek, Park County	10

Past Inactivity in Street Lighting Has Left a Big Field for New Work

What improved street lighting has done for cities shown can be accomplished in every town and city.

A—Multiple gas-filled tungsten lamps are mounted inside stippled glass globes on State Street, Chicago.

B—Shows clusters of three 6.6-amp. luminous-arc lamps per pole on Main Street, Salt Lake City.

C—On Broadway, Los Angeles, are two-globe standards, also containing luminous-arc lamps.

D—Grant Avenue, San Francisco, is lighted by standards carrying two 6.6-amp. luminous-arc lamps each.

Calculating Battery Sizes for Locomotives

Method of Figuring the Energy Consumption Is Based on the Division of the Load Cycle Into Sections According to Train Weights and Grades—Number of Plates in Battery Determined on Basis of Energy Used and Discharge Rate

By J. H. TRACY
Engineering Department, Electric Storage Battery Company, Philadelphia

IT IS frequently necessary for electrical engineers to make calculations of the approximate size of batteries for locomotives having a certain duty cycle. The first step in this procedure, the determination of the watt-hours output for the duty cycle, is independent of the type of battery to be selected. However, after the energy consumption is determined and the maximum rate of discharge calculated the selection of the battery size will depend on the characteristics of the particular type of battery chosen.

To determine the energy consumption the typical round trip should be divided into as many parts as have different characteristics such as different weights of train and different grades to be encountered. The requirements of each of these sections in each direction of haul should be treated separately. For purposes of illustration a problem may be taken as follows:

Assume 600 ft. of level track and 800 ft. of 1.2 per cent grade. A 3-ton locomotive is to be used and the load to be hauled is a 15-ton trailing load in the direction against the grade and a 6-ton trailing load in the direction with the grade. The work calls for twenty round trips per day and it is desired to use a forty-eight-cell battery.

The round trip can be divided into three parts—first, a travel of 800 ft. up a 1.2 per cent grade, the load and locomotive totaling 18 tons; second, the return trip light load or empties down a 1.2 per cent grade, total 9 tons; third, all level running can be grouped, using the full distance and the average load, which would mean a distance of 1,200 ft. with a 13.5-ton train.

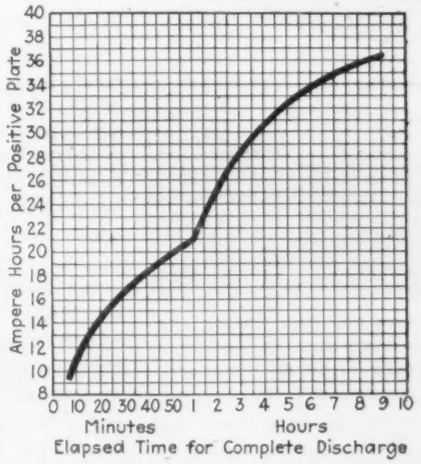


FIG. 1—VARIATION OF CAPACITY WITH ELAPSED TIME OF DISCHARGE FOR A TYPE "MV EXIDE" BATTERY

The tractive effort to overcome friction for level running is determined by multiplying the weight of the train, including locomotive, in tons by 30 lb. To find the tractive effort for grade multiply the grade expressed in per cent by 20 and multiply this by the weight of the train in tons. This tractive effort is taken as positive for an up grade and negative for a down grade. To get the total tractive effort add that required for level running and the tractive effort required for grade. If this sum is negative, it means the train is coasting and no power is required.

After the total tractive effort for a certain part of the trip has been determined it may be reduced to watt-hours per train-mile for that section of the trip by multiplying by 3.

The derivation of this factor comes from the fact that 1 watt-hour equals 2,655 ft.-lb., which is practically ½ mile-lb. Therefore tractive effort in pounds multiplied by 2 equals watt-hours per train-mile at the locomotive wheels. Assuming 66⅔ per cent efficiency between the battery and the wheels, substitution can be made as follows:

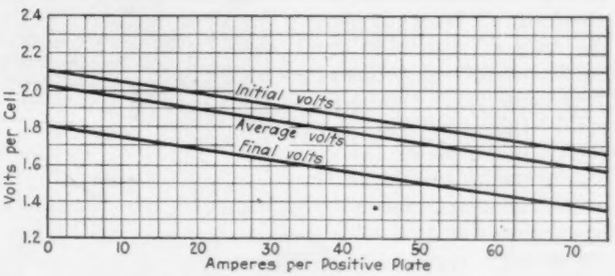


FIG. 2—INITIAL, AVERAGE AND FINAL VOLTS FOR A TYPE "MV EXIDE IRONCLAD" BATTERY AT VARIOUS RATES OF DISCHARGE

$$(\text{Tractive effort} \times 2) \div 0.66\tfrac{2}{3} = \text{watt-hours per train-mile at the battery.}$$

This reduces to:

$$\text{Tractive effort} \times 3 = \text{watt-hours battery per train-mile.}$$

Returning to the problem at hand, the first part of the round trip can be calculated as follows:

18 tons × 30 lb. per ton friction = 540 lb. tractive effort for friction.

1.2 per cent grade × 20 lb. per percentage per ton × 18 tons = 432 lb. tractive effort for grade.

The total tractive effort is therefore 972 lb. and multiplied by 3 equals 2,916 watt-hours per mile for the first section of 800 ft.

As there are twenty round trips for this section of the haul, the total distance in miles is (20 × 800) ÷ 5,280 = 3.03 miles. As previously determined, the watt-hours per mile is 2,916; therefore the total watt-hours is 3.03 × 2,916 = 8,830.

In the same way the second part of trip may be calculated. As this run is for 800 ft. down a 1.2 per cent grade, the tractive effort for grade will be negative. Therefore the total tractive effort is 270 lb. + (— 216 lb.) = 54 lb. The energy consumption is 3 × 54 × 3.03 = 491 watt-hours.

As the third part of the trip is a run of 1,200 ft. on level track, the tractive effort required is simply that to overcome friction. Therefore 13.5 tons × 30 lb. per ton friction = 405 lb. tractive effort × 3 = 1,215 watt-hours per mile. The distance in miles for the twenty trips is 4.55, and so the energy consumption is 5,530 watt-hours.

The total energy consumption for the twenty round trips for the complete run is the sum of the requirements found for the three parts or 8,830 + 491 + 5,530 = 14,851 watt-hours.

DETERMINING THE BATTERY SIZE

Up to this point the procedure is the same regardless of the battery which may finally be chosen. The actual determination of the battery size is, however, dependent on the type of battery being considered and under certain conditions on the rate of discharge. In order to give a specific illustration of how the general method is applied, the "MV Exide Ironclad" battery, which varies from seven to thirty-three plates, has been used.

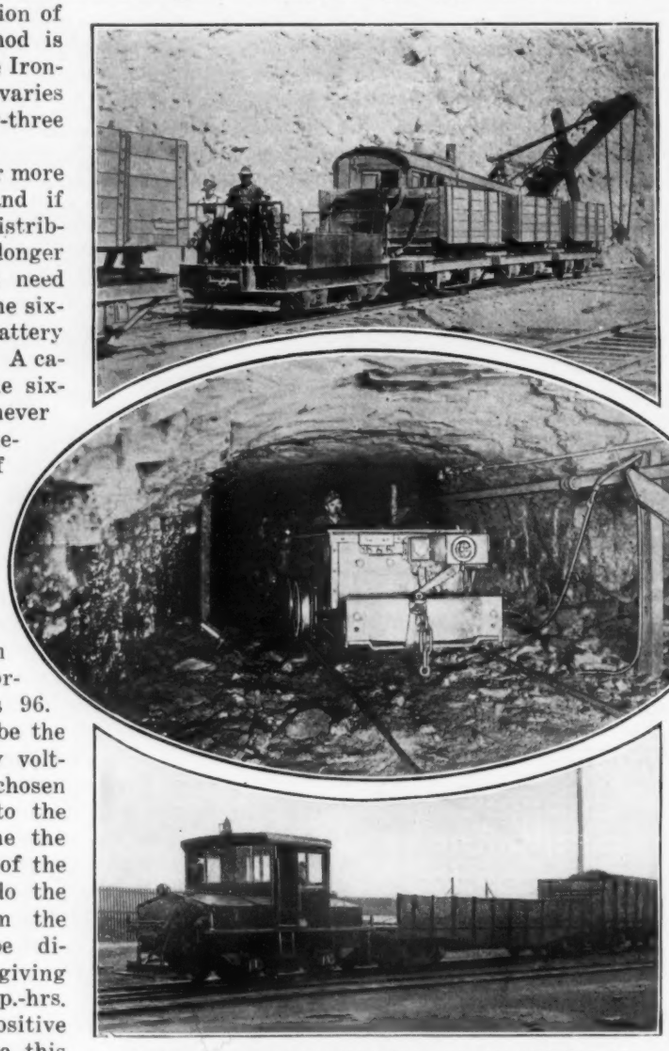
If there are fifteen or more cycles of operation and if these operations are distributed over six hours or longer the rate of discharge need not be considered, as the six-hour capacity of the battery will be fully available. A capacity in excess of the six-hour capacity should never be used as a basis for determining the size of the battery required.

The battery voltage is equal to number of cells multiplied by 2, and as the number of cells chosen in the problem was forty-eight, the corresponding voltage is 96. The procedure might be the reverse as the battery voltage is sometimes chosen and the cells fitted to the voltage. To determine the ampere-hour capacity of the battery required to do the work in the problem the watt-hours should be divided by the voltage, giving 14,851 ÷ 96 = 155 amp.-hrs.

The number of positive plates per cell to give this capacity is dependent on six-hour capacity of a single plate, which is 34 ampere-hours. Therefore 155 ÷ 34 gives the number of positive plates or four and a half. The nearest larger whole number should be taken, which would give five positive plates for the battery. To get the total number of plates per cell multiply the number of positive plates by 2 and add 1, as there is always an odd number of plates. In this case the battery required to do the work would be a forty-eight-cell battery of eleven plates per cell.

When the battery is to be used for service requiring less than fifteen cycles, or when the total elapsed time during which discharges are taken is less than six hours, or when both of these conditions are involved, the curves in Figs. 1 and 2 give the necessary data for the "MV Exide Ironclad" battery. In Fig. 1 is shown the variation in available capacity with elapsed time of discharge for a positive plate, and Fig. 2 shows the initial, average and final voltages per cell at various discharge rates.

If, for instance, there are more than two and one-half cycles per hour but the elapsed time is less than six hours, the calculation for the size of the battery is the same as given above except that the average voltage per cell will not be 2. In this case to get the average voltage per cell divide the ampere-hours per positive plate (Fig. 1) corresponding to the total elapsed time by the elapsed time in hours to get the amperes discharge per positive plate. Then, from Fig. 2, read the average voltage per cell corresponding to this discharge rate and multiply this value by the number of cells, to get the average battery voltage. Then divide the total watt-hours required by this average voltage to get the total ampere-hours required. To get the number of positive plates in a cell divide the total ampere-hours' capacity required by the ampere-hours per positive plate, as read on the curve of Fig. 1 for the total elapsed time. If the number of cycles is less than fifteen and the elapsed time is more than six hours, it is necessary to consider the maximum rate of discharge as well as the total watts of battery capacity. In this case a relatively large proportion of the battery capacity is used in each cycle and at high rates, and these high rates have an effect on the available battery capacity which must be allowed for in choosing the proper size of battery. For example, the following problem may be taken:



STORAGE-BATTERY REQUIREMENTS FOR INDUSTRIAL AND MINE LOCOMOTIVES MUST BE CAREFULLY STUDIED IF THE PROPER SIZE BATTTERY IS TO BE USED

Top—At the quarry of the California Portland Cement Company in "Death Valley."
Center—Electric haulage in coal mines is in many cases very nearly on a definite trip basis.
Bottom—A 15-ton locomotive used for moving cars at the plant of the Newport News Shipbuilding Company.

Assume a 75-ton trailing load and a 25-ton locomotive operating up 300 ft. of 3 per cent grade and down the same grade with a load of 25 tons, five round trips, a forty-eight-cell battery, speed with full load up 3 per cent grade 1.25 miles per hour.

It will be found by following the same method as in the previous problem that the energy requirements will be 27,000 watt-hours per mile, which is used entirely on the up grade as the tractive effort for down grade is negative and overbalances the tractive effort for friction. The total distance traversed is 0.284 mile, so the

energy consumption is 7,670 watts for the five round trips.

As the rate of speed is 1.25 miles per hour and the rate of energy consumption is 27,000 watt-hours per mile, the maximum rate of discharge is 27,000 × 1.25 = 33,700 watts. To get the equivalent time of complete discharge at the maximum rate, the rate of discharge should be divided into the total watt-hours energy consumption. Therefore, 7,670 ÷ 33,700 = 0.228 hour, or 13.7 minutes. From the curve of Fig. 1, 12.5 ampere-hours corresponds to the equivalent time of 13.7 minutes (0.228 hour), which divided by 0.228 hour gives 55 amp. discharge per positive plate. From Fig. 2 the average voltage corresponding to 55 amp. discharge is 1.66 volts per cell, or 79.9 volts for the forty-eight cells. As in the previous problem, divide the watt-hours by the voltage to get the ampere-hours of battery capacity. In this case

$$7{,}670 \div 79.9 = 96 \text{ ampere-hours}$$

As the capacity of the positive plate has already been found to be 12.5 ampere-hours, the number of positive plates required would be 96 divided by 12.5, or 7.6. The battery would therefore be made up of forty-eight cells with seventeen plates.

If the equivalent time for discharge is less than ten minutes, the battery size will have to be determined by the maximum permissible rate of discharge. For work of the character described this should not exceed 67 amp. per positive plate.

For example, if only two round trips were required of the locomotive used in the previous example, the equivalent time of discharge would be only 5.46 minutes. Therefore 67 amp. can arbitrarily be taken as the discharge rate. From Fig. 2 the voltage per cell would be 1.58, or 76 volts for the battery. In that case if the maximum rate of discharge is 33,700 watts and the battery voltage is 76, the amperes maximum discharge would be 33,700 divided by 67, or 444 amp. The rate, however, must be held to 67 amp. per positive plate, therefore the number of positive plates would be 444 divided by 67, or 6.6 positive plates. The battery in this case would consist of forty-eight cells made up of fifteen plates per cell.

In these calculations the determination of the battery size is reliable from the point where the watt-hour capacity and maximum rate of discharge are known. The calculations of energy consumption are based on certain approximations such as 30 lb. per ton for tractive effort. This figure is usually considered sufficient to include an allowance for curves as well as some allowance for tracks which are not up to good railroad standard.

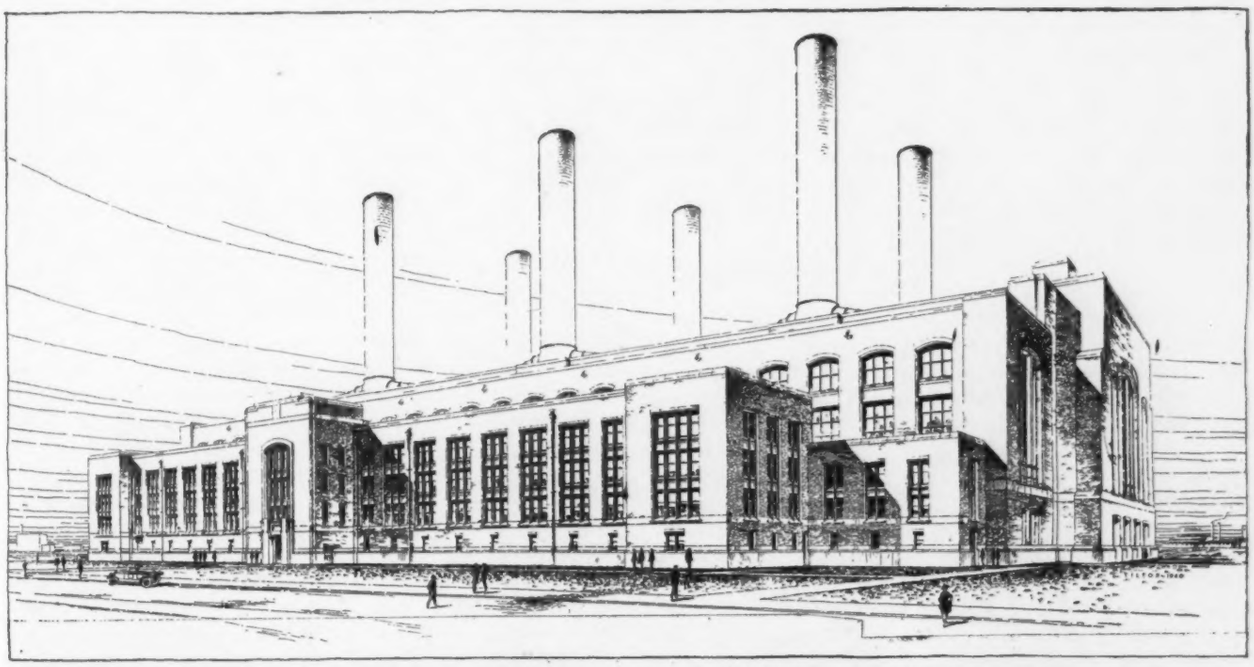
The efficiency of 66⅔ per cent assumed between the battery and locomotive wheels includes an allowance for rheostatic and braking losses as well as motor and gear losses. Different values may be assigned to these constants as the judgment of the engineer making the approximations may dictate.

Features of New Commonwealth Edison Station

Steam Will Leave Boilers at 685 Deg. Fahr.— Feed Water Will Enter Economizers at 175 Deg. Fahr. to Avoid Condensation of Acid Gases

VIRTUALLY all of the latest features of power-plant design will be incorporated in the Calumet station of the Commonwealth Edison Company, which is now in the course of erection, according to a description of the plant given by Alexander D. Bailey, superintendent of generating stations, before the Mechanical Engineering Section of the Western Society of Engineers and the Chicago Section, American Society of Mechanical Engineers. High boiler pressure and superheat, economizers with steel tubes and headers, preheating of furnace air, high feed-water temperatures for economizers and two sets of revolving screens at the condenser-water intake were a few of the plant's characteristics to which reference was made.

The boilers are Babcock & Wilcox cross-drum type



CALUMET STATION WILL EVENTUALLY CONTAIN SIX 30,000-KW. TURBO-GENERATORS

with 20-ft. (6.1-m.) tubes 4 in. (10 cm.) in diameter. Each contains 15,089 sq.ft. (1,388 sq.m.) of steam-making surface. The boilers are built for 350-lb. (24.6 kg. per sq.cm.) pressure and 250 deg. of superheat supplied by 4,000 sq.ft. (368 sq.m.) of superheating surface. At this pressure and superheat steam will leave the boilers at 685 deg. Fahr (363 deg. C.). There are four boilers per unit in the plan, but the first two units are to be served by seven boilers of the size previously given. The guaranteed evaporation from each boiler is 150,000 lb. (68,000 kg.) of water per hour, amounting to about 300 per cent of normal rating.

There are to be two forced-draft Coxe chain-grate stokers per boiler, having an active area of 376 sq.ft. (34.6 sq.m.) and a ratio to the steam-making surface of one to forty. With a head room of 20 ft. (6.1 m.) from the grate to the tubes, the furnace of each boiler will have a volume of 6,700 cu.ft. (190 cu.m.), which reduces to nearly 18 cu.ft. per square foot of grate area, or to 0.36 cu.ft. per pound of coal burned per hour, figuring on a combustion rate of 50 lb. of coal per square foot of grate per hour. The steel stacks serving the boilers will be considerably shorter than at the other stations. They will be 16 ft. (4.8 m.) in diameter and rise 167 ft. (51 m.) above the grate. Forced-draft fans, each having a capacity of 50,000 cu.ft. (1,415 cu.m) per minute, will serve the boilers, and the induced-draft fans drawing the gases from the economizers will require 200-hp. motors to drive them.

ECONOMIZERS WILL BE USED

Economizers with steel tubes and steel headers will be installed. There will be one per boiler, containing 9,600 sq.ft. (883 sq.m.) of surface split up into three sections with the tubes running crosswise with the boiler tubes. In the use of these economizers a net gain of about 10 per cent in economy is anticipated, adding about 7 or 8 per cent to the possible 74 or 75 per cent obtainable from the boilers without the economizers. To guard against the condensation of sulphurous-acid gases on the steel economizer tubes, the temperature of the feed water before entering the economizer is to be raised to 175 deg. Fahr. (79.5 deg. C.). At this temperature any condensation of sulphurous gases should be avoided and the life of the economizer prolonged. To obtain it sufficient steam will be bled from the lower stages of the main turbines.

In addition to the economizer an air preheater of the plate type is under consideration. The gases will leave the economizer at about 350 deg. Fahr. (177 deg. C.). By the use of the preheater their temperature would be reduced over 100 deg. Fahr. (37.8 deg. C.), the air for the boiler furnaces being preheated to about 200 deg. Fahr. As a better generator of sulphurous acid could scarcely be obtained when coal containing nearly 5 per cent of sulphur is being used, the installation of the preheater is doubtful, although a try-out may be given to one of them.

Continuous bucket elevators will be used to elevate coal to the level of the overhead bunker, and from here belt conveyors will distribute it to the bunker. In crushing the coal an innovation is to be the use of a Bradford breaker. This breaker will be unusually heavy and substantial and will automatically pass out the scrap iron, slate, etc., which so frequently put out of action the roll-type crushers employed in the other plants. Ashes from the hopper under the stoker will be dumped directly into railway cars at grade, as the plant has been built at a sufficient elevation to permit this practice.

One of the two generating units now being installed is a General Electric seven-stage impulse machine having highest economy at three-quarters load. Steam is to be delivered to the turbines at 300-lb. pressure (21 kg. per sq.cm.) and about 225 deg. Fahr. (107 deg. C.) of superheat, giving a final steam temperature of approximately 650 deg. The speed is 1,800 r.p.m. The other turbine is a tandem compound Westinghouse machine of the same type as the one installed at the Northwest station.

Plans have been made for a six-unit station, but at the present time only two 30,000-kw. units are going in. The power-plant buildings are to consist of a switch house, transformer house, turbine room and boiler house. Just enough of the new structures are to be completed to house the first two units. Both turbo-generators are rated at 30,000 kw. at 85 per cent power factor, three-phase, 60-cycle, and will generate at 12,000 volts with a speed of 1,200 r.p.m. Two 33,000-volt cable lines will connect the new plant with the Fisk and Quarry Street stations. Incidentally, this is the highest voltage ever carried in a cable.

Each turbine will be served by a surface condenser containing 52,000 sq.ft. (4,784 sq.m.) of surface, or about 1.73 sq.ft. (0.16 sq.m.) per kilowatt of generator rating. The circulating pump will have a capacity of 55,000 gal. per minute. It will be motor-driven, as will be all auxiliaries in the plant with the exception of the boiler-feed pumps. Three out of the four pumps installed will be turbine-driven. For operating the oil switches 230-volt direct current will be used, and for auxiliary motors above 50 hp. 2,300-volt, 60-cycle alternating-current power. For the smaller motors 440-volt service will be provided. The use of high-voltage alternating-current service on the larger auxiliary motors is an innovation for the company.

In the condenser special washers are to be provided which will allow cleaning the condenser while in operation. To reduce hand labor there will be double sets of revolving screens at the intake for condenser circulating water. In the other stations double sets of stationary screens and one revolving screen have been employed.

One of the interesting points in the development of stations of this company has been the increasing area occupied by the boiler equipment. In each new station the boiler-room area has shown considerable increase, and in addition the boiler room has gone farther up into the air and farther down into the ground, until at the new Calumet station the boiler room takes just 65 per cent of the total building area.

By means of charts it was shown that the fuel costs run about 81 to 82 per cent of the station generating costs, and at the Calumet station they will be about 86 per cent. The pounds of coal per kilowatt-hour are being reduced constantly, but with the price of coal going up there has been a continuous increase in its cost per kilowatt-hour generated. With coal such a large item, higher-priced men are being sent into the boiler room. In fact, much of the money paid for labor is apportioned to this division of the plant. In reply to an inquiry concerning the plant economy anticipated, Mr. Bailey said that it was expected to generate a kilowatt-hour on 19,000 B.t.u.

Applying Relays to Large Power Systems

Considering a Typical System of Stations and Substations, Relay Selections Are Made to Insure the Orderly Functioning of Circuit Breakers—Detailed Analysis of Reverse-Power Relay Characteristics

By R. F. GOODING
Superintendent of Construction, Tucker & Laxton, Charlotte, N. C.

DIFFERENTIAL relays are particularly useful in isolating generators and transformers from the system in case of internal trouble in these units, and radial feeders are best protected by overload relays, as pointed out in an article by the writer published in the ELECTRICAL WORLD of Feb. 19. This discussion is continued in the present article to cover the characteristics of reverse-power relays, especially useful for parallel feeder service. Group feeder relays are considered, and finally a typical system is outlined and analyzed to show just what relays are best adapted to the various elements from generating station to remote substations.

On large systems it is often desirable to interchange power between two power stations, and this is especially desirable when the load characteristics are such that the peak loads on the two stations do not coincide. For this purpose several parallel feeders are run between the stations, and these are protected by cross-connected reverse-power relays as shown in Fig. 2. This diagram shows four such tie lines, but this number can be increased or decreased as necessity may demand. It will be noted that the current from any particular current transformer divides, part going through its own relay, the other part through the similar relays on the other circuits but in opposite direction. For instance, with 5 amp. secondary current in all circuits (normal full load) the current from transformer on circuit *A* will divide, $3\frac{3}{4}$ amp. going through relay *A* and $1\frac{1}{4}$ amp. in the opposite direction through relays *B* and *C* and *D* in series. The current is inversely proportional to the impedance of the two circuits. As this same condition exists in the other relays, the resultant current through each one will be zero.

ANALYSIS OF REVERSE-POWER-RELAY ACTION

The table shows the different stages of this scheme, and the best way to get a clear idea of its operation is to study this table. To begin with, station No. 2 is assumed to be supplying power to station No. 1, and this direction of power will hold for all of the "conditions." The + or — sign above each figure shows direction of current to trip relays at each station. No potential connections are shown.

Condition 1.—Assume normal operation, with 5 amp. secondary current in current transformers at station No. 1. It will be seen, as pointed out before, that each transformer is supplying to its own relay $3\frac{3}{4}$ amp., but *not* in the tripping direction, while it also supplies $1\frac{1}{4}$ amp. *in* tripping direction to the three other similar relays. There is, therefore, no current through the relays at station No. 1.

MAGNITUDE OF CURRENT IN CROSS-CONNECTED REVERSE-POWER RELAYS (FIG. 2) UNDER DIFFERENT CONDITIONS

The + and − signs show direction to trip relays at each station; + indicates energy flow *up* through the relay; — sign means energy flow *downward*.

Condition	Description	Relay	Current Due to D	C	B	A	Total Current	Relay	Current Due to D	C	B	A	Total Current	Relay	Current Due to D	C	B	A	Total Current	Relay	Current Due to D	C	B	A	Total Current	Remarks;
1	Normal operation 5 amp. in current transformer station No. 1	D-1	+ $3\frac{3}{4}$	— $1\frac{1}{4}$	— $1\frac{1}{4}$	— $1\frac{1}{4}$	0	C-1	— $1\frac{1}{4}$	+ $3\frac{3}{4}$	— $1\frac{1}{4}$	— $1\frac{1}{4}$	0	B-1	— $1\frac{1}{4}$	— $1\frac{1}{4}$	+ $3\frac{3}{4}$	— $1\frac{1}{4}$	0	A-1	— $1\frac{1}{4}$	— $1\frac{1}{4}$	— $1\frac{1}{4}$	+ $3\frac{3}{4}$	0	No current in relays at station No. 1.
2	Same as No. 1, but for station No. 2	D′-1	+ $3\frac{3}{4}$	— $1\frac{1}{4}$	— $1\frac{1}{4}$	— $1\frac{1}{4}$	0	C′-1	— $1\frac{1}{4}$	+ $3\frac{3}{4}$	— $1\frac{1}{4}$	— $1\frac{1}{4}$	0	B′-1	— $1\frac{1}{4}$	— $1\frac{1}{4}$	+ $3\frac{3}{4}$	— $1\frac{1}{4}$	0	A′-1	— $1\frac{1}{4}$	— $1\frac{1}{4}$	— $1\frac{1}{4}$	+ $3\frac{3}{4}$	0	No current in relays at station No. 2.
3	Assume 40 amp. ground at *O*, and 15 amp. load at station No. 1	D-1	+ $8\frac{3}{4}$	— $2\frac{1}{2}\frac{1}{2}$	— $2\frac{1}{2}\frac{1}{2}$	+ 5	+ $7\frac{1}{2}\frac{1}{2}$	C-1	— $2\frac{1}{2}\frac{1}{2}$	+ $8\frac{3}{4}$	— $2\frac{1}{2}\frac{1}{2}$	+ 5	+ $7\frac{1}{2}\frac{1}{2}$	B-1	— $2\frac{1}{2}\frac{1}{2}$	— $2\frac{1}{2}\frac{1}{2}$	+ $8\frac{3}{4}$	+ 5	+ $7\frac{1}{2}\frac{1}{2}$	A-1	— $2\frac{1}{2}\frac{1}{2}$	— $2\frac{1}{2}\frac{1}{2}$	— $2\frac{1}{2}\frac{1}{2}$	— 15	— $23\frac{1}{4}$	Oil breaker *A* will be tripped by relay *A*-1.
4	Assume same 15 amp. load at station No. 1, instant after breaker *A* trips	D-1	+ $3\frac{3}{4}$	— $1\frac{1}{4}$	— $1\frac{1}{4}$	0	+ $1\frac{1}{4}$	C-1	— $1\frac{1}{4}$	+ $3\frac{3}{4}$	— $1\frac{1}{4}$	0	+ $1\frac{1}{4}$	B-1	— $1\frac{1}{4}$	— $1\frac{1}{4}$	+ $3\frac{3}{4}$	0	+ $1\frac{1}{4}$	A-1	— $1\frac{1}{4}$	— $1\frac{1}{4}$	— $1\frac{1}{4}$	0	— $3\frac{3}{4}$	Current in relay *A*-1 in direction to keep breaker *A* open.
5	Same as No. 3, but for relay station No. 2	D′-1	+ $8\frac{3}{4}$	— $2\frac{1}{2}\frac{1}{2}$	— $2\frac{1}{2}\frac{1}{2}$	— 5	— $2\frac{1}{7}\frac{1}{8}$	C′-1	— $2\frac{1}{2}\frac{1}{2}$	+ $8\frac{3}{4}$	— $2\frac{1}{2}\frac{1}{2}$	— 5	— $2\frac{1}{7}\frac{1}{8}$	B′-1	— $2\frac{1}{2}\frac{1}{2}$	— $2\frac{1}{2}\frac{1}{2}$	+ $8\frac{3}{4}$	— 5	— $2\frac{1}{7}\frac{1}{8}$	A′-1	— $2\frac{1}{2}\frac{1}{2}$	— $2\frac{1}{2}\frac{1}{2}$	— $2\frac{1}{2}\frac{1}{2}$	+ 15	+ $6\frac{1}{4}$	Current in relay *A′*-1 will trip breaker *A*.
6	Same as No. 4, but for relay station No. 2	D′-1	+ $3\frac{3}{4}$	— $1\frac{1}{4}$	— $1\frac{1}{4}$	— 10	— $8\frac{3}{4}$	C′-1	— $1\frac{1}{4}$	+ $3\frac{3}{4}$	— $1\frac{1}{4}$	— 10	— $8\frac{3}{4}$	B′-1	— $1\frac{1}{4}$	— $1\frac{1}{4}$	+ $3\frac{3}{4}$	— 10	— $8\frac{3}{4}$	A′-1	— $1\frac{1}{4}$	— $1\frac{1}{4}$	— $1\frac{1}{4}$	+ 30	+ $26\frac{1}{4}$	Relay *A*-1 will trip breaker *A*, if not already tripped by condition 5.
7	Same as No. 6, but with breaker *A* open	D′-1	+ $3\frac{3}{4}$	— $1\frac{1}{4}$	— $1\frac{1}{4}$	0	+ $1\frac{1}{4}$	C′-1	— $1\frac{1}{4}$	+ $3\frac{3}{4}$	— $1\frac{1}{4}$	0	+ $1\frac{1}{4}$	B′-1	— $1\frac{1}{4}$	— $1\frac{1}{4}$	+ $3\frac{3}{4}$	0	+ $1\frac{1}{4}$	A′-1	— $1\frac{1}{4}$	— $1\frac{1}{4}$	— $1\frac{1}{4}$	0	— $3\frac{3}{4}$	Current in relay *A′*-1 will not tend to trip breaker *A*.
8	Same as No. 4, but with relay *A*-1 short-circuited	D-1	+ $3\frac{3}{4}$	— $1\frac{1}{4}$	— $1\frac{1}{4}$	0	0	C-1	— $1\frac{1}{4}$	+ $3\frac{3}{4}$	— $1\frac{1}{4}$	0	0	B-1	— $1\frac{1}{4}$	— $1\frac{1}{4}$	+ $3\frac{3}{4}$	0	0	A-1	0	0	0	0	0	No current in relays at station No. 1.
9	Same as No. 7, but with relay *A*-1 short-circuited	D′-1	+ $3\frac{3}{4}$	— $1\frac{1}{4}$	— $1\frac{1}{4}$	0	0	C′-1	— $1\frac{1}{4}$	+ $3\frac{3}{4}$	— $1\frac{1}{4}$	0	0	B′-1	— $1\frac{1}{4}$	— $1\frac{1}{4}$	+ $3\frac{3}{4}$	0	0	A′-1	0	0	0	0	0	No current in relays at station No. 2.

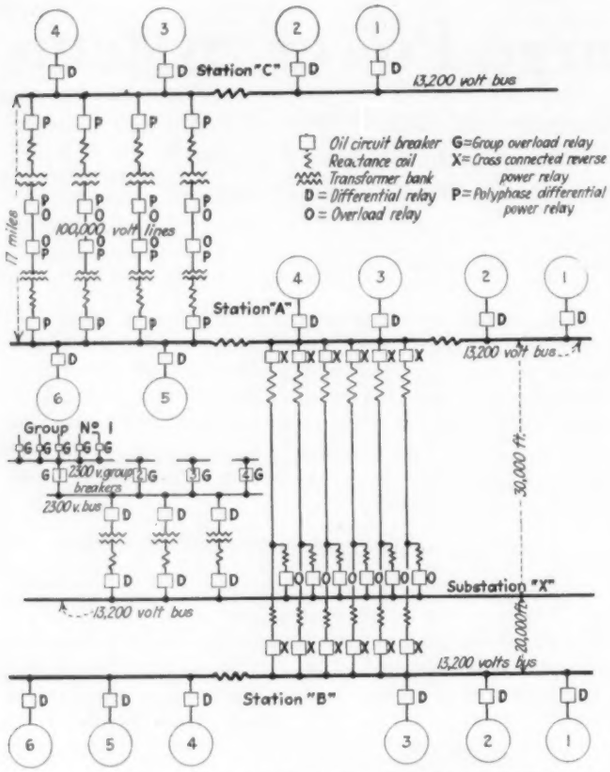


FIG. 1—HOW RELAYS MAY PROTECT A TYPICAL SYSTEM

Condition 2.—This assumes 5 amp. secondary current in the current transformers at station No. 2, and conditions are identical with those existing at station No. 1. In other words, under normal conditions there will be no current in the relays at either station.

Condition 3. — This condition assumes a 40-amp. (secondary-current) ground at point *O* on feeder *A* and a 15-amp. load on station No. 1. The 40-amp. ground current will be divided, one-half coming from station No. 1 and one-half from station No. 2.

Taking relay *A*-1 first, it will have from its own relay 15 amp. in the tripping direction, and from each of relays *B*-1, *C*-1 and *D*-1, 2 ½ amp. also in the tripping direction, making a total of 23½ amp. in the tripping direction. Thus breaker *A* will be tripped by relay *A*-1. The total current in transformer for relay *A*-1 is 20 amp., the amount this line is supplying to the ground. This 20 amp. divides, 15 amp. through its own relay in tripping direction and 5 amp. in non-tripping direction through *B*-1, *C*-1 and *D*-1.

With a load of 15 amp. at station No. 1, the three lines corresponding to relays *B*-1, *C*-1 and *D*-1 will each carry 5 amp. In addition to this they must also supply the 20 amp. ground current (6⅔ amp. each), making a total of 11⅔ amp. through their current transformers. This assumes that station No. 1 is a substation or a generating station with no generators on the bus. Taking transformer for relay *B*-1, this current will divide as follows—three-fourths, or 8¾ amp. (non-tripping), through relay *B*-1; one-fourth, or 2½ amp. (tripping), through relays *A*-1, *C*-1 and *D*-1. Similar conditions will exist through relays *C*-1 and *D*-1. The total current in relay *B*-1 then will be 5 amp. (non-tripping) from *A*-1, less 2½ amp. (tripping) each from *C*-1 and *D*-1, with 8¾ amp. (non-tripping) from its own transformer. This makes a total of 7½ amp. in the non-tripping direction, so breaker *B* will not trip. As conditions for *C*-1 and *D*-1 are identical with those for *B*-1, these breakers will also stay closed.

Condition 4.—The instant after breaker *A* trips, relay *A*-1 will still have 1¼ amp. (tripping) from feeders *B*, *C* and *D*, making 3¾ amp. (tripping) tending to keep breaker *A* open. Relay *B*-1 will receive no current from feeder *A*, but will have 3¾ amp. (non-tripping) of its own and 1¼ amp. (tripping) from feeders *C* and *D*, making 1¼ amp. (non-tripping) total current—same values for relays *C*-1 and *D*-1.

Condition 5.—This makes same assumptions as condition 3, but for station No. 2.

The total current in transformer for relay *A'*-1 is 20 amp., 15 amp. (tripping) going to relay *A'*-1 and 5 amp. (non-tripping) to relays *B'*-1, *C'*-1 and *D'*-1; but from feeders *B*, *C* and *D* relay *A'*-1 receives 2½ amp. (non-tripping) each, or 8¾ amp. (non-tripping) total, making the total resultant current 6¼ amp. (tripping) and tripping breaker *A'*.

Relay *B'*-1 receives 8¾ amp. (tripping) of its own, 5 amp. (non-tripping) from feeder *A* and 2½ amp. (non-tripping from feeders *C* and *D*, making a total resultant current of 2½ amp. (non-tripping). Breaker *B'* will therefore stay closed, as will also breakers *C'* and *D'*.

Condition 6.—The instant after breaker *A* trips, the total current in transformer for relay *A'*-1 will be 40 amp. (ground current), 30 amp. (tripping) through relay *A'*-1 and 10 amp. (non-tripping) to relays *B'*-1, *C'*-1 and *D'*-1. But relay *A'*-1 is also receiving 1¼ amp. (non-tripping) from feeders *B*, *C* and *D*, making a total of 26¼ amp. (tripping). Thus breaker *A'* will be tripped, if not already opened by condition 5. (Had the ground current been assumed at 20 amp. or 30 amp. instead of 40 amp. this condition would be more apparent.) Relay *B'*-1, *C'*-1 and *D'*-1 need not be considered in detail here.

Condition 7.—After breaker *A'* opens, the resultant current in relay *A'*-1 is found to be in the non-tripping direction.

Condition 8-9.—When a circuit breaker opens, its relays are automatically short-circuited, so there will be no current in the relays for feeder *A*. The load formerly carried by the four feeders is now taken care of by the three remaining ones, and normal conditions have been restored. This scheme actually operates with "almost human intelligence," and, better yet, it is not apt to "lose its head" as an operator might do in an emergency.

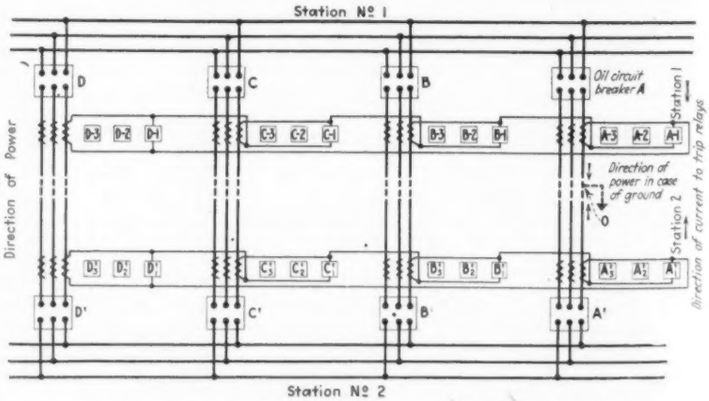


FIG. 2—CROSS-CONNECTED REVERSE POWER RELAY SCHEME APPLIED TO FOUR PARALLEL LINES

At substation X (Fig. 2) the 2,300-volt breakers are

shown in groups of five, each group having its own group breaker. This is done in order to obviate the necessity of using a breaker of high rupturing ability on each 2,300-volt circuit, thereby reducing the cost of breakers, structure, etc. The idea here is that a short-circuit on a 2,300-volt feeder will immediately open the breaker for that group. The opening of the group breaker will then trip the breaker on the damaged feeder, after which the group breaker will automatically reclose, restoring service to the other feeders of the group. As this scheme is somewhat complicated and of rather limited application, it will not be discussed in detail.

When one leg of a circuit becomes grounded, one of two things may happen—either the ground may immediately develop into a short circuit or it may be of rather high resistance with insufficient current to trip the breaker, in which case it may "hang on" for quite a while. An overload relay placed in the neutral (secondary) of the current transformers, as shown in Fig. 3, may be used to remedy the latter trouble. Under normal conditions, the currents in other parts of the circuit being equal, there will be no current through this relay, but if conditions become disturbed, as just described, the unbalanced current in the neutral will cause the relay contacts to close, tripping the breaker. When such a scheme is used it is impossible for the operator to tell whether a breaker opened on a short circuit or a ground, but the fact that the breaker did open is evidence to him that there is something wrong on that circuit, and he should immediately take steps to locate the fault and remove it. It is interesting to note in this connection that the cross-connected reverse-power relays will often trip a circuit on a ground before the ground develops into a "short."

CHOICE OF RELAYS FOR A TYPICAL SYSTEM

Having outlined the various relay schemes, our next step is to see what applications should be made on a system such as shown in Fig. 4. The radial feeders from various stations have been omitted from this sketch, as they are shown in Fig. 1.

We find on studying Fig. 1 that all generators are equipped for differential protection. The power transformers at substation X likewise have differential relays.

On the transformer banks between stations A and C polyphase differential power relays give the differential protection needed, while straight overload relays are

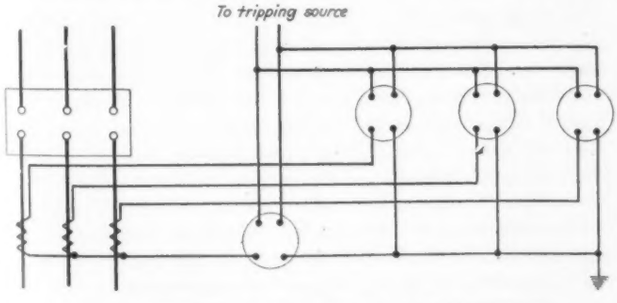


FIG. 3—GROUNDED LINE IS QUICKLY DISCONNECTED BY RELAY IN NEUTRAL WIRE

added to take care of line troubles. These overload relays would operate on the high-tension breakers only, isolating the 100,000-volt line, but leaving the transformer bank "alive." If it seemed advisable, connections could easily be made so that the overload relays would trip both high-tension and low-tension breakers.

On the 13,200-volt tie lines between stations A and B the cross-connected reverse-power relays would be used. If conditions between stations A and C are the same as between A and B, the cross-connected scheme can be applied instead of the differential and overload scheme just outlined. As a rule, however, these 100,000-volt lines would be run in different directions to insure continuity of service. Therefore, these lines would be of unequal lengths, unequal resistance, etc., and the cross-connected scheme would not be so easily applied in their case. For the tie lines supplying substation X plain overload relays will suffice, as their main duty is to protect the substation apparatus. At substation X the group system can be used for the 2,300-volt distribution system. The group breaker, or one controlling every set of five smaller breakers, would be set for almost instantaneous operation, as its high rupturing ability will allow this. The sequence of operation here should be as rapid as possible, in order to restore service on the remaining circuits of the group with the least possible delay.

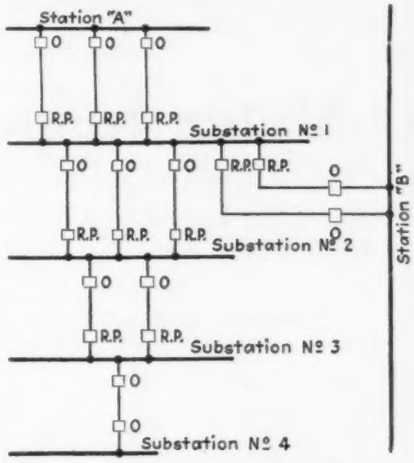


FIG. 4 — COMBINED REVERSE-POWER AND OVERLOAD RELAY PROTECTION FOR RADIAL FEEDERS

Fig. 4 shows three parallel feeders leaving a power station—say A—and supplying several substations Nos. 1, 2, 3 and 4. The feeders leaving station A and substations Nos. 1-2, 2-3, and so on, are equipped with overload relays, but where these lines go into the various substations reverse-power relays are used. For instance, if trouble should develop at substation No. 3, the overload relays at substation No. 2 would operate and clear the trouble. But suppose a ground should occur on one of the lines between 2 and 3, then the overload relay at 2 would operate and isolate that end of the line. The remaining good line between 2 and 3 would tend to supply current to the fault, but this would cause the reverse-power relays at 3 to function, thus completely isolating the damaged line from the system. As there is only one feeder from 3 to 4, there is no occasion for reverse-power relays, and plain overload relays would be used on both ends of this line.

At substation No. 2 are shown two incoming lines from station B in addition to the three from station A (through substation No. 2). These two lines would have overload and reverse-power relays, the same as from station A possibly—however, with a different time setting.

The overload relays are so set that the ones farthest from the source of power operate in the shortest time. In this case, if relays at substation No. 4 are set for one-half second, there might be found one second for No. 3, one and one-half seconds for No. 2, two seconds for No. 1 and two and one-half seconds for station A.

As these substations are normally supplied from station A, with station B as an emergency source of power, the overload relays at station B would probably have a low setting, say one second, so that trouble originating at these substations could not seriously affect the system supplied from station B.

All of the reverse-power relays shown in Fig. 4 would have a low time setting. If the breakers will stand the service, these should be set for practically instantaneous operation.

There are many other combinations of relays that might be discussed in this connection, such as balanced current protection for parallel lines (instead of cross-connected reverse-power relays), mechanically balanced differential relay for two parallel lines, balanced power protection between two parallel lines, etc. As stated before, however, the study of relays is a never-ending process, and it is not in the scope of this article to discuss all schemes, but merely to bring out the salient points of the ones most commonly used.

Regular Meter Inspection as Money Saver

Inherent Errors of Meters Are Not So Serious as Much Larger Discrepancies May Result from Improper Connections, Miscalculated Ratios and Existence of Both Three-Wire and Four-Wire Service from Same Transformers

By A. L. JOHNSTON
Manager Electrical Construction Department for H. C. Felver, Industrial Engineering and Contracting, Pottsville, Pa.

SINCE the income of lighting and power companies is almost entirely dependent on metering, it is very important that the metering devices should register accurately and that the meters with their potential and current transformers should be properly connected and of proper ratio.

Notwithstanding the precautions taken by most companies of any size, the writer believes that many power systems have metering equipments and installations which are causing the companies thousands of dollars' loss annually, much of which could be detected by a careful general inspection without the necessity of checking the meter against a standard. In fact, a superficial general inspection will sometimes show discrepancies probably not discoverable in a routine test.

Numerous cases can be recalled which illustrate this contention. In one particular instance a consumer had 400-amp. current transformers, ratio 400 to 5, connected to a meter calibrated for 200-amp. current transformers, ratio 200 to 5. The result was that the meter registered only one-half of the load which it should have registered, and as this condition had continued for three years the loss involved a total of $10,000 for this one installation. In another case the wrong gear train was discovered on a meter registering a 400-kw. load and the resultant registration was one-half of what it should have been. The loss was very considerable as the condition had continued for years. It is quite probable that this irregularity would have escaped undetected in a routine test.

Many errors arise through the difficulty of tracing out the current and potential secondary wiring. This is usually eliminated by the use of a standard color scheme. Experience has shown that it is desirable to use solid colors, as red, white and blue for potential and red, green and black for current, red being used for the grounded middle wire in both instances. Solid colors are more desirable on account of the ease with which a marker in the braid becomes obscured by dirt or coal dust. Some companies carry the idea further and paint the color scheme on the meter to aid the less experienced metermen in connecting up the meter correctly.

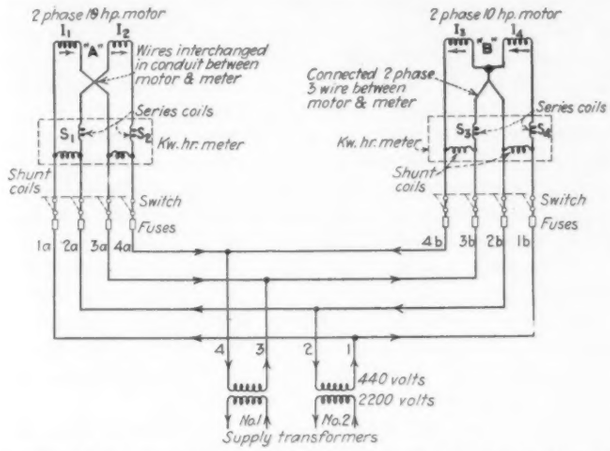
A very common error familiar to all metermen is to find the shunt coil of a meter supplied with potential from one phase and the corresponding series coil supplied with current from a different phase, or to find the current or potential reversed. If the potential and current in the same element are both reversed and are opposite in polarity to that shown in the diagram of connections as furnished by the manufacturer, the meter will register correctly. Comprehensive detail tests for the accuracy of meter connections are given in the "Electrical Meterman's Handbook," N. E. L. A., 1912.

Where two-phase is used for power there are usually cases of metering errors to be found due to the fact that some companies permit both three-wire and four-wire connections from the same set of power transformers. Recalling a special case, a consumer who may be designated as B raised objection to the amount of his power bill. On testing the meter it was found to be within the prescribed limits of accuracy when checked against a rotating standard. It was discovered, however, that when the one and only motor on the premises was idle the meter still showed a load of approximately one-third of what it did when the motor was running. On tracing out the wiring it was noted that the conduit between the meter and the motor contained a two-phase, three-wire system instead of two-phase, four wires. The two middle wires were spliced within the conduit to one wire. This of itself could give rise to no such irregularity as existed, the series coils of the meter being connected to measure the current properly and the potential coils being connected to the proper phases. The only other load on the transformers supplying this motor was about four blocks away, where there were a two-phase motor of the same size and a similar metering equipment. A careful inspection of the wiring of this second motor disclosed that four wires were run to the motor but that inside the conduit one wire of each phase was interchanged with the other.

Calling the latter consumer A, it is evident by referring to the diagram of connections shown herewith that A's motor could not have been started up had it been the only motor on that set of transformers, since both phases of the motor would have been operating in series with the two transformers and this would have been equivalent to running on single-phase. But on account of the two middle wires being tied together inside B's premises A's motor was able to operate satisfactorily on what was really a two-phase, three-wire system. By tracing out the diagram of connections it will be evident

how this condition causes B's meter to run approximately 50 per cent faster than it should and at the same time causes A's meter to run at approximately one-half speed.

Referring to the accompanying diagram again and assuming for simplicity that the power factor in both cases is unity and that the same amount of current flows



UNUSUAL CONNECTIONS THAT CAUSED INCORRECT REGISTRATION

through the phases of both motors, it is interesting to trace the current:

From transformer No. II it goes through wire 1, 1-*b*, series coil of meter *S*-4, one phase of B's motor, 2-*b*, wire 2, back to transformer No. II. From transformer No. I through wire 3, 3-*b*, series coil *S*-3 of B's meter, through remaining phase of B's motor, 4-*b*, wire 4, and back to transformer No. I. As the potential coils on B's meter are connected in a proper manner the meter thus far registers power accurately.

Considering A's motor, current leaves transformer No. II, passing through wire 1, to the left through 1*a*, one phase of A's motor, 3*a*, 3*b*, series coils *S*-3 of B's meter, in the same direction but in quadrature with the former current in this coil, back through 2-*b*, wire 2, and to the transformer from which it started.

Note that in this case the current did not pass through a series coil of the meter in A's possession and that this phase of the motor was not metered.

Starting from transformer No. I, the current passes through wire 3, to the right through 3*b*, series coil *S*-3 of B's meter, in the same direction and in phase with the first current through this winding, through 2*b*, 2*a*, series coil *S*-1 of A's meter, through the second phase of motor, through series coil *S*-2 of A's meter, 4*a*, wire 4 and back to tranformer No. I.

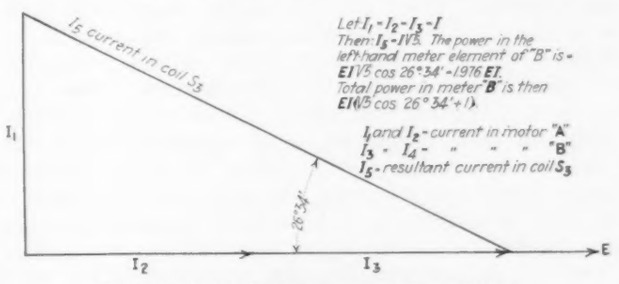
The current in the potential coil, operating with the series coil *S*-1, is approximately in quadrature with the current in *S*-1, being connected across a different phase, and the element of this meter will not cause registration. In the other element of the meter the shunt and series currents are in phase and will cause one phase of the motor to be metered. This meter registers one-half of what it should. Considering B's meter, it is seen that the current in the series coil *S*-4 operates in phase with the potential as above noted, and this element records correctly. In the other element the current in the coil *S*-3 is $I\sqrt{5}$ as shown on the vector diagram and is about 26 deg. out of phase with the voltage in the shunt coil. The resultant registration for this element is very nearly twice what it should be, thus causing the meter as a whole to record 50 per cent fast.

Another case, different from the above, is recalled for which there would appear to be no excuse. In metering a two-phase mining load of about 500 hp. the series coils of an indicating wattmeter were connected in parallel with the series coils of a watt-hour meter. Assuming the impedance of the series coils to be all equal, the resultant registration as indicated by the meter would be one-half what it should have been. This condition, incredible as it may seem, had existed for about fifteen years.

Large errors in metering are somtimes detected by the simple expedient of estimating the motor load and timing the speed of the disk of the meter. Some meters are designed to run twenty-five revolutions per minute at full load. For others it is necessary to know the watt-hour or watt-second constant of the rotating element, as indicated on the disk of the meter, in order to determine the load. As an example of this superficial test assume a 50-amp., 500-volt, polyphase watt-hour meter registering the power taken by a 50-hp. motor which one believes to be running close to full load and to be taking about 36 kw. Since the full load for the meter is 50 kw., its speed should be $(36 \div 50) \times 25 =$ 18 r.p.m. Now, if the rotating element of the meter runs only 10 r.p.m., there is reason to suspect its accuracy and further investigation should be made.

Where the full-load speed of the meter is not known, the disk constant must be used and the checking of the meter as above is equally simple. Assuming the same motor load as above and that the disk constant of the meter is 20 watt-hours, the kilowatt load on the meter as recorded is equal to $(20 \times \text{r.p.m.} \times 60) \div 1{,}000$. Now, if the speed of the meter is 18 r.p.m., the recorded load will be, according to this formula, 21.6 kw. This would be too great a discrepancy to allow to pass without further investigation.

It would materially assist in the detection of errors if the load corresponding to one revolution of the disk per minute were indicated on the name plate, taking into account the ratios of the current and potential transformers. Some companies follow the practice of using 5 amp. watt-hour meters on their systems. The power consumption is, of course, multiplied by a constant depending upon the above ratios. When it is necessary to install larger capacity transformers the constant is changed. Another aid to the detection of errors is to


I_5 current in coil S_3
Let $I_1 = I_2 = I_3 = I$
Then: $I_5 = I\sqrt{5}$. The power in the left-hand meter element of "B" is = $EI\sqrt{5}\cos 26°34' = 1.976\,EI$.
Total power in meter "B" is then $EI(\sqrt{5}\cos 26°34' + 1)$.
I_1 and I_2 = current in motor "A"
I_3 = I_4 = " " " "B"
I_5 = resultant current in coil S_3
I_1
26°34'
I_2
I_3
E

RELATION OF CURRENTS IN CIRCUITS SHOWN IN ACCOMPANYING DIAGRAM

have where possible a totalizing meter which will check against several separate meters.

If errors in metering were not so surprisingly frequent and costly, their simplicity would prevent mentioning them except as of academic interest. The losses are, however, so very considerable and the probability of the bills being adjusted after a lapse of time is so remote that no efforts should be spared for their prevention.

Readers' Views and Comments

This is a readers' forum. Comments on questions before the electrical industry presenting economic, financial, engineering or commercial aspects and new or supplementary viewpoints on published articles are cordially invited

Quick Solution of Line-Drop Problems

To the Editor of the ELECTRICAL WORLD:

SIR: In looking over the voltage-drop chart inserted in the ELECTRICAL WORLD for May 28, page 1238, with my article entitled "Chart for Quick Solution of Line-Drop Problems," I find two or three points which should have some explanation or correction.

There is no reference on the chart itself to the fact that it covers 60-cycle lines of stranded copper conductors only. Referring to No. 2 conductor, top line, this should have been marked 15-ft. instead of 10-ft. spacing. The correction curve would probably have been more readily understood had it been marked "subtract percentage correction from drop at receiver to obtain drop from generator to receiver."

Your readers undoubtedly noticed that, for the example worked out in the text, the constant K was printed 20 instead of 200.

E. P. PECK,
General Superintendent Electrical Department.
Utica (N. Y.) Gas & Electric Company.

Utilities, Not Engineer-Bankers Alone, Should Educate Investors on Their Securities

To the Editor of the ELECTRICAL WORLD:

SIR: I have read with interest your editorial in the ELECTRICAL WORLD of May 21 on the need for an executive-engineer-banker in the electrical industry. Without attempting to discuss the matter at length, I would offer one or two suggestions which may prove beneficial.

First—There are already many engineer-bankers in financial circles. The partners of many of our larger bond houses graduated into financial circles from engineering. They are thoroughly conversant with conditions in the electrical industry as well as in financial affairs. In my opinion the banking profession is well equipped to understand the problems of the light, power and traction companies. Funds for the development of such companies come ultimately from the investor and not from the banks. In some instances banks may purchase issues of bonds, but they are distributed ultimately through the bond houses or through the banks' own distributing salesmen to the private investor. In days gone by, when there was such a thing as a capitalist in this country, the bonds and stocks of new enterprises were purchased and held either in bank loans or by the capitalist until they could be distributed. But such funds are no longer available.

Second—Irresponsible jitney and other competition, the restrictive attitude of public service commissions and the tremendous increased cost of labor and supplies, on the one hand, and the denial of rate increases to offset these factors, have so hampered the traction investment field that such financing is extinct. Not only is it extinct, but it rises up from its grave and casts its black shadow over light and power financing. Many an investor in this country in the past few years has been caught between the devil of the traction strike and the deep, very blue sea of receivership—and in many instances he has had to face both ways at the same time.

Third—Banks, investing institutions and bond dealers, or individual investors, will purchase electric light and power securities because they believe this part of the industry is relatively free from labor troubles and the business can be made comparatively stable, provided that rates are by definite agreement made commensurate with costs of supplies, including coal. However, in this branch of public utility financing even, conditions have changed materially and the competition of foreign and domestic government loans has so raised the price of capital as to make it prohibitive under the old rates and public service restrictions.

The remedy for these conditions and the loosening up of capital for light and power financing lies not in the creation of a new national engineer-banker, but in the education of the investing public by those most deeply interested—that is, by the light and power companies through their national organizations.

1. The general investor must be shown that his property values are safe and that his securities are protected as to earnings. The citizen in the territory served must be shown that if he does not encourage the investment of capital he will lose the service. Two objects can be accomplished at once by the sale of junior securities in a local community. Junior financing is accomplished and every citizen is made a partner in the enterprise.

2. A sliding scale of charges for service should be provided in some legal form, as has been done with success in several instances. The scale should not only include the price of material and supplies but also the price of labor and capital.

3. Sufficient returns should be allowed on new construction to encourage investment in such new construction. The expansion of the industry and the development of new enterprises will never be accomplished as long as the reward is dependent simply upon the economies which can be effected in the art itself.

The light and power companies are well equipped to enter such a campaign of education of the private investors. The newspapers, monthly magazines and general publications will be not only glad to publish discussions of this problem, but will be anxious to do so.

Campaigns which many concerns have conducted to sell preferred stock to their customers have resulted in tremendous good and in my opinion have been responsible in many instances for the changed attitude of public service commissions and the public behind them. The physical merger of large interconnected systems will, undoubtedly, result in many economies which will bring some benefits to the consumers, some profit to the stockholders of the various companies involved and some additional element of safety for the senior security holders in increased net earnings available for interest charges. But the development of service for each community can never be accomplished until the general investing public has concrete evidence that its investment is safe and profitable.

No engineer-banker, single-handed, can do this work of educating the public and the investor. No banker, bond dealer or investment bankers' group can be expected to do this work, because these interests are all concerned in general financing—other financing as well as public utility financing. It rests with the light and

power companies alone to see that the public shall be educated so that its property and earnings will be protected and that thereafter the investor shall be shown that his investment is both safe and profitable.

Harvey Fisk & Sons, New York City. F. O. MARCH, Vice-president.

Analysis of English Investigator's Comment on Sparking Voltages in A. I. E. E. Rules

To the Editor of the ELECTRICAL WORLD:

SIR: An editorial in the ELECTRICAL WORLD for April 9, 1921, has called my attention to the paper of Dr. Alexander Russell on "Sparking Voltages Between Spherical Electrodes" in the *Journal* of the (British) Institution of Electrical Engineers for October, 1920.

Dr. Russell does not give any new experimental results but limits his investigation to an analysis of existing data. In this are included the curves given in the Standardization Rules of the American Institute of Electrical Engineers, as well as other data extending back some twenty-six years. As a result of a mathematical study Dr. Russell concludes that the curves of the A. I. E. E. for the case where one sphere is earthed or grounded are incorrect because of apparent inconsistencies between the mathematical study and the experimental results. His speculation as to the probable cause of the apparent inconsistencies, namely, that the earthed sphere was not at zero potential because the neutral and the end of the testing transformer winding were both grounded at the same time, is, from the practical standpoint, impossible. This is, of course, obvious when it is considered that the transformers used in making these tests had capacities varying from 200 kva. to 500 kva. and that the power was often connected for several hours.

There can be no reasonable doubt that the experimental curves as given in the A. I. E. E. rules are correct within the limits claimed. The data were obtained and checked independently by separate investigators.* Any appreciable error would have been found in the many tests made during the years that the gap has been in use, as there is always a check in the way of a voltmeter coil, transformer ratio or step-down transformer with a crest voltmeter.

If Dr. Russell had consulted the original papers published in the *Transactions* of the Institute, his conclusions would probably have been quite different, since virtually all the points that puzzled him were not only pointed out in 1913-1914 but thoroughly discussed. The equations for the gradient and the spark-over voltage of the gap were also given at that time.

It may help to go briefly over the points under discussion. Dr. Russell's analysis consists in mathematically calculating from the measured voltage the gradient at which breakdown occurs for different sizes of spheres at different spacings. It seems reasonable to expect a constant value for each size of sphere if the calculations can be correctly made. These calculations show that over a prescribed range of spacing the gradient at breakdown is constant when both spheres are insulated. When one sphere is grounded or earthed the mathematical calculation of the gradient does not give a constant value for the apparent strength of air. So far I agree with Dr. Russell and I have pointed this out in the discussion in 1913 referred to above and upon other occasions since then.

The gradient is calculated from the experimental data as follows:

$$g = (e/x)f \text{ kv. per cm.}$$

where

g = gradient,
e = measured voltage,
x = spacing,
f = a factor calculated from geometrical dimensions.

The factor f is different for the grounded and non-grounded cases. In determining f mathematically, because of complications, it is necessary to neglect the effect of shanks, connecting leads, the distance above ground, etc., and to make the calculations for two spheres in space at given potentials. For the case in which both spheres are insulated the above factors have very little influence at the spacings used in practice. Where one sphere is earthed or grounded, however, they may have a decided influence. It was for this reason that we determined the factor f experimentally. It differs considerably from the mathematical value. In fact, the distance above ground and the size of the shanks have a considerable influence. For this reason the size of shank and distance above ground are specified in the Institute rules.

The deviation noted by Dr. Russell could be due to error in the measured e, to the potential of the grounded sphere or to the mathematical f. Since in the measured curves there can be no reasonable question as to the accuracy of e, or as to the fact that the grounded sphere was at zero potential, the cause of the deviation must be in the mathematical f. It is easy to demonstrate experimentally that the apparent increase in the gradient is due to the mathematical f, which does not take into account the effect of surrounding objects. The question is discussed in the references given above.

It is interesting to note that the formulas given by Dr. Russell for the strength of air at the sphere-gap surface at the instant of discharge check well with those derived by us in 1913.

Dr. Russell finds:

$$R_{\max.} = 27.4 + (14.1/\sqrt{a}) \text{ kv. per cm.}$$

$$E = \frac{x}{f}\left(27.4 + \frac{14.1}{\sqrt{a}}\right) \text{kv.}$$

Our original formulas were:

$$g_s = 27.2\left(1 + \frac{0.54}{\sqrt{R}}\right) \text{kv. per cm.}$$

$$e = \frac{x}{f} 27.2\left(1 + \frac{0.54}{\sqrt{R}}\right) \text{kv.,}$$

which put in the same form and terms given by Dr. Russell become:

$$R_{\max} = 27.2 + \frac{14.7}{\sqrt{a}} \text{kv. per cm.,}$$

$$E = \frac{x}{f}\left(27.2 + \frac{14.7}{\sqrt{a}}\right) \text{kv.}$$

The formulas are identical with the exception of a small difference in the constants. The check is quite remarkable when it is considered that Dr. Russell used the data of a number of investigators extending over a long period of time.

F. W. PEEK, JR., Consulting Engineer.
General Electric Company, Pittsfield, Mass.

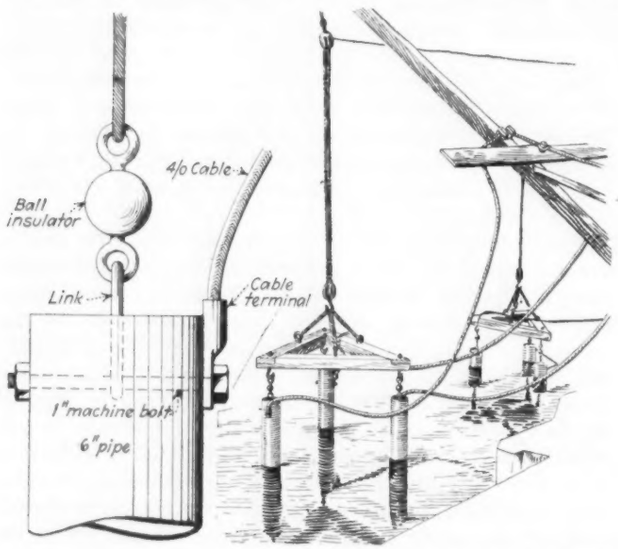
*Chubb and Fortescue, "Calibration of the Sphere-Gap Voltmeter," *Transactions A. I. E. E.*, February, 1913, Vol. 32, page 739; Peek, discussions, *Transactions A. I. E. E.*, February, 1913, page 812; Peek, "Sphere Gap as a Means of Measuring High Voltage," *Transactions A. I. E. E.*, June, 1914, Vol. 33, page 923; Peek, "Dielectric Phenomena in High-Voltage Engineering," pages 92 and 93, McGraw-Hill Book Company.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Fresh-Water Rheostat Handles 900 Kw. at 4,000 Volts

A MEANS for loading a 1,000-kw., 4,000-volt, three-phase, waterwheel-driven generator to full capacity was desired recently for a test at the new power plant of the Lockwood Manufacturing Company, Waterville, Me. The conditions of the test were that the load should



BALANCED CURRENTS OF 128 AMP. AT 4,000 VOLTS WERE TAKEN BY THIS RHEOSTAT

be maintained with little variation for long periods and that it should be easily controlled and quickly adjusted to widely different values. The fresh-water rheostat was decided upon as best meeting these conditions.

Attempting to determine the final form of rheostat to be used, the specific resistance of the water not being known, the writer first constructed a rheostat of three 10-ft. lengths of 6-in. iron pipe hung in a straight line, each outer electrode being spaced 15 ft. from the center electrode. With each electrode immersed 8 ft., this rheostat was expected to carry a balanced load of about 1,500 kw. at 4,000 volts, but the load actually obtained was 300 kw., with phase currents of 50, 25 and 50 amp. respectively. A second rheostat was then constructed, using the three 10-ft. lengths of 6-in. pipe hung in an equilateral triangle with 4-ft. sides. The load obtained with the electrodes immersed 9 ft. 6 in. was 392 kw. with phase currents of about 57, 53 and 60 amp. The final rheostat was composed of the second one and another unit made of three 10-ft. electrodes hung in an equilateral triangle with 3-ft. sides, the two elements or triangles being hung on 15-ft. centers. The electrodes of the two units were connected in parallel, but unsymmetrically. With all electrodes immersed 9 ft. 6 in. the load obtained was 890 kw. at 4,000 volts, with phase currents of about 128 amp. balanced within 0.1 per cent. The load for any setting of the electrodes remained within 0.2 per cent for hours at a time. With only a gentle flow of water there was no dissipation of heat perceptible to the eye. Had the electrodes been long enough to immerse 10 ft. 8 in., the load would have been about 1,000 kw.

The rheostats were hung in a forebay about 18 ft. deep and several hundred feet wide. The water was somewhat affected by industrial wastes from upstream, which caused the specific resistance of the water to vary from day to day. The only structure near the electrodes was an iron intake grating, electrically neutral and about 15 ft. distant on one side only.

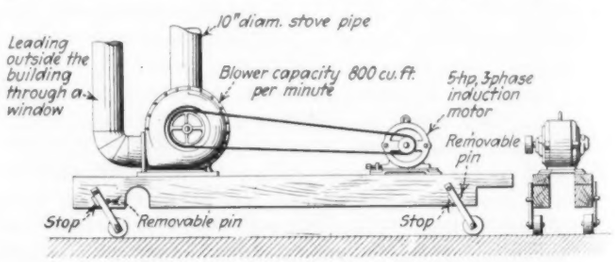
It appears from the results of the tests that the load varied with the separation of the electrodes and that a symmetrical arrangement is necessary for satisfactorily balanced loads.

D. J. LOCKE,
With Albert S. Richey, Electrical Engineer.
Consulting Engineer,
Worcester, Mass.

Removing Dust from Building When Blowing Out Generators

WHEN blowing out generators in a Canadian plant a great deal of trouble was experienced some time ago because the dust from one generator was blown into the other machines and was never removed from the building. To remedy this difficulty the writer designed a box tent which was placed over the machine being worked on. When the dust is blown from the windings it is drawn out of the tent through a pipe connected to a blower and discharged on the outside of the building. The man inside wears a gas mask while blowing the dust from the windings with an air hose.

Iron pipe 1¼ in. in diameter is employed for the frame of the tent. This is fastened together with pipe brackets and U-bolts. Cross pieces of ½-in. pipe run across



EXHAUST OUTFIT FOR BLOWING OUT GENERATORS

the frame near the bottom to steady it. Each upright member has a flat fitting at its lower end to give a steadier support. The exhaust pipe is made of 10-in. stove pipe in 3-ft. sections. The end entering the tent is fastened in a sheet-iron plate which rests on two cross-pipes at the top of the frame. The exhaust line is also of stovepipe, which is led through a window to the outside of the plant. The blower and the motor are

set on two timbers. For convenience in handling, rollers have been fastened to the timbers on pivoted arms as shown.

When the blower is to be placed in operation the rollers are let up into the recesses cut in the timbers, which then rest firmly on the floor. When it is desired to move the outfit the rollers are let down and the pins are inserted in place. One man can move the unit with very little trouble. R. H. N. LOCKYER.

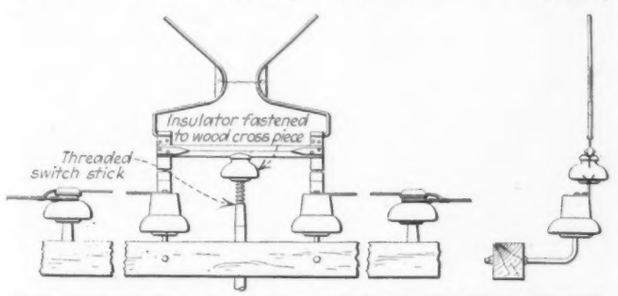
Bonnington Falls, B. C., Canada.

Fused Horn-Gap Cut-Out and Disconnecting Switch

FREQUENTLY in construction work an inexpensive primary cut-out is needed that will safely handle the current it may be called upon to break and that can be quickly and cheaply installed. In such work there may be several transformer banks that are installed only for a short time, and some device is needed whereby each may be cut off from the others in case of trouble, or to permit repairs to connected apparatus. High-voltage oil switches are desirable, but the expense of these is prohibitive. For several years the San Joaquin Light & Power Corporation has used a bracket with a fuse contained in a porcelain tube for such purposes where the load did not exceed 10 amp. This gave good results, but when heavy currents were broken in this fuse the arcs were so severe that the tube and holders were sometimes destroyed.

As an improvement on this arrangement the porcelain tube was replaced with horns of copper rod and the gap, equivalent to double the spark-over distance for the voltage used, was closed with fuse wire. Tests on a 50-kva., 11,000-volt transformer showed that the arc was quickly extinguished after the fuse had blown. A number of sets of these horn-gap cut-outs were used on one of the large construction projects completed during the past year and gave results which have been very satisfactory.

The method of installation is clearly shown by the cut. The threaded stick in the center is used to place or remove the cut-out, after which it is unscrewed from the insulator in the center. The cut-out is intended only as a protective and disconnecting device and has not been used to switch on or off apparatus carrying current. In an emergency the current can be quickly



THIS INEXPENSIVE SWITCH IS OF VALUE ON CONSTRUCTION WORK

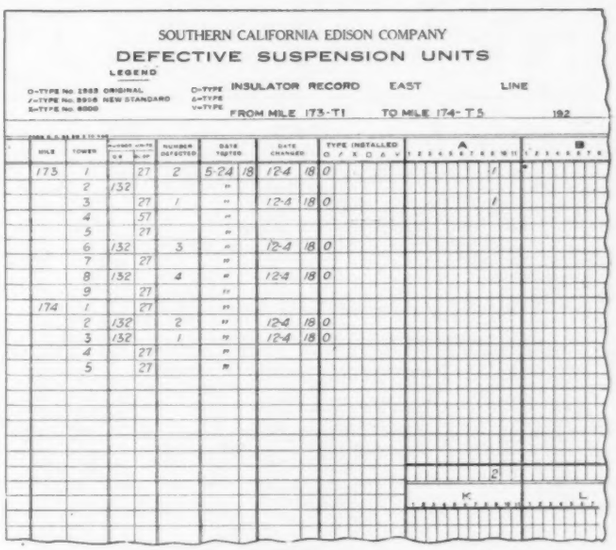
Threaded stick is used for handling gap which is mounted on horizontal wooden crosspiece

broken by mechanically breaking the fuse wire with the switch stick, after which the cut-out is removed and re-fused when it is ready to be placed again in service. HARRY L. WOOD.

San Joaquin Light & Power Corporation,
Fresno, Cal.

Records Show Life of Suspension Insulators

ANALYSES of insulator failures and tabulations to show the life of suspension-insulator units placed in various positions in the strings of insulators have been made available through the use of a complete record-keeping system devised by the Southern California Edison Company. These records are kept on the insulators on the 240-mile, 150,000-volt Big Creek transmission line of that company. The Big Creek line consists of two single-circuit steel-tower lines with the conductors insulated by nine suspension units in suspension and two strings of eleven units each in parallel on dead-ends. All of the units on the line are meggered at about one-year intervals, and the results are entered in surveyor's field books by the patrolmen who make the test. In these books are indicated the mile


SOUTHERN CALIFORNIA EDISON COMPANY

DEFECTIVE SUSPENSION UNITS

LEGEND

INSULATOR RECORD EAST LINE

FROM MILE 173-T1 TO MILE 174-T5 192

MILE	TOWER	NUMBER UNITS IN STR.	NUMBER DEFECTIVE	DATE TESTED	DATE CHANGED	TYPE INSTALLED	A	B
173	1	27	2	5-24 18	12-4 18	O	1	
	2	132		"				
	3	27	1	"	12-4 18	O	1	
	4	27		"				
	5	27		"				
	6	132	3	"	12-4 18	O		
	7	27		"				
	8	132	4	"	12-4 18	O		
	9	27		"				
174	1	27		"				
	2	132	2	"	12-4 18	O		
	3	132	1	"	12-4 18	O		
	4	27		"				
	5	27		"				

THESE RECORDS CONSTITUTE COMPLETE HISTORIES OF INSULATOR UNITS

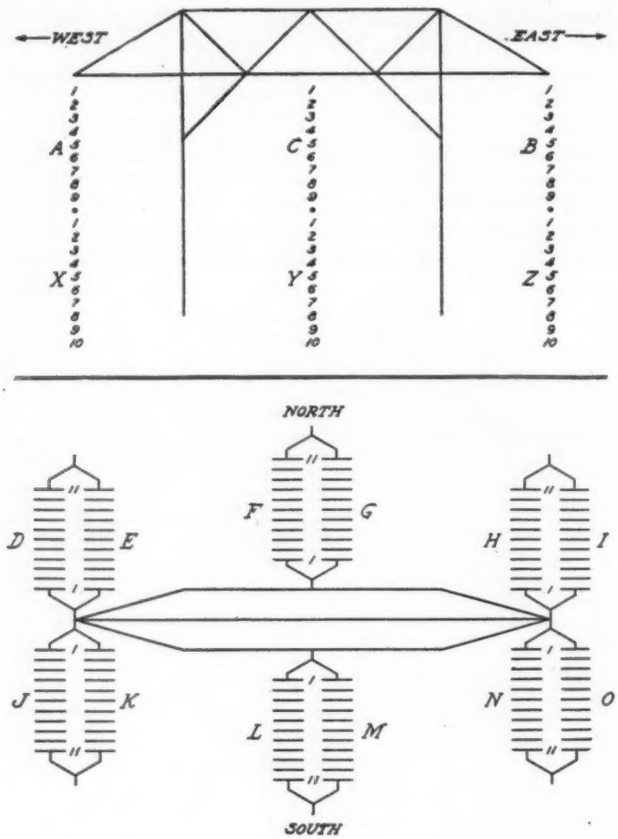
Each sheet is 12½ in. x 28 in. and is bound in a ledger-type binder

and tower number, the kind of construction (whether suspension, dead-end or tie-downs), the make of the insulators, the total number of insulators tested on each tower, the number of insulators found defective, the position in the particular strings of the defective units, the date when the defective insulators were changed, the type of insulators removed and the type of insulators installed to take their places. If there are two or more defective units in one string at the time the megger tests are made, these are changed immediately, but if there is only one in a particular string found defective, they are not changed at that time, but left until some future date when all of the defective units in a particular section are changed.

The field books are turned in to the office of the chief patrolman, who enters the records on a loose-leaf form sheet as shown in the cut. There is sufficient space on each of these sheets to enter the records of the insulator tests on twenty towers. The sheets are made in duplicate, one set being for the general office and the duplicate set for the use of the chief patrolman. On the front of these sheets are shown the number of insulators on each tower, the number found defective on the towers, the date of the test and the date when the insulators were changed, together with the make of the

insulator. As shown on the reverse side of the sheet, to each of the strings of insulators on the several types of tower construction a letter is given to designate it, and the individual units are numbered, begining with the one nearest the attachment to the tower.

Interesting data as to the character of the country traversed by the line is printed on the back of one of



THESE DIAGRAMS ARE USED IN KEEPING RECORDS OF INSULATORS

The diagrams are printed on the back of the record sheet shown on the preceding page. Each string on a tower is given a designating letter and each insulator in the string has a number.

these sheets, which is of use in analyzing the cause of insulator failures.

The average life of the suspension insulator has not yet been determined. By the systematic use of this method of keeping the records the average life of the different types of insulators and of insulators in different localities and in different string positions will be obtained.

S. R. VAN DREZER,
Chief Patrolman of Big Creek Lines.
Southern California Edison Company,
Kern, Cal.

Automatic Operation of Substation in Emergency

THE effectiveness of automatic substations for light and power service was shown recently when trouble occurred on the system of the St. Paul Gas Light Company. The trouble began on one of the trunk lines and caused a momentary drop in voltage. The line was not cleared immediately, and all of the synchronous apparatus at the manual station was put out of service. The automatic substation cleared itself from the line but was restored automatically to service in a few seconds. It helped to take care of the direct-current network, which was immediately picked up automatically by a storage battery at the manual station. The voltage on the direct-current system dropped from 240 to 180. The contactors on the line panel of the automatic substation opened, cutting in resistance. This station continued giving service, however, through this resistance until enough of the manual station equipment was brought back into operation to restore service to normal. The period of trouble lasted for about five minutes.

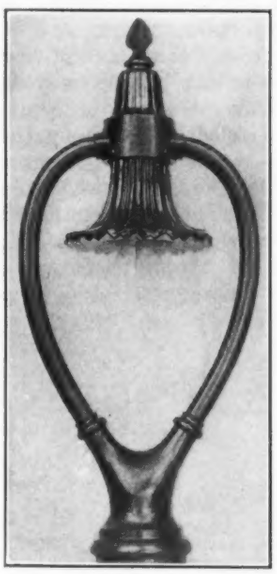
The automatic substation installed on the system of the St. Paul Gas Light Company was the first automatic substation ever put into use in light and power work, according to the Westinghouse Electric & Manufacturing Company. The substation was placed in operation some months ago, and the result has been entirely satisfactory.

Extensions on Cross-Arm Braces Support Ground Wires

AN ARTICLE under this heading published in the ELECTRICAL WORLD for April 30, page 995, through mistake appeared over the name of A. N. Voss. As a matter of fact the article was contributed by J. J. Luchessa, chief electrician of the Miami Copper Company, Miami, Ariz.

Globeless Street-Lighting Unit

GLOBELESS standards for series incandescent street lighting have been adopted by the city of Rochester, N. Y. About two hundred of these units were installed in an endeavor to secure an attractive and efficient lighting system for a residential district, with a minimum initial and upkeep expense. The globeless unit does away with the absorption of a diffusing globe, which, according to the General Electric Company, may be as high as 25 per cent to 40 per cent.



NO GLOBE EMPLOYED WITH THIS LIGHTING STANDARD

One piece of porcelain serves for insulator, reflector and socket holder. Lamp is bowl-frosted.

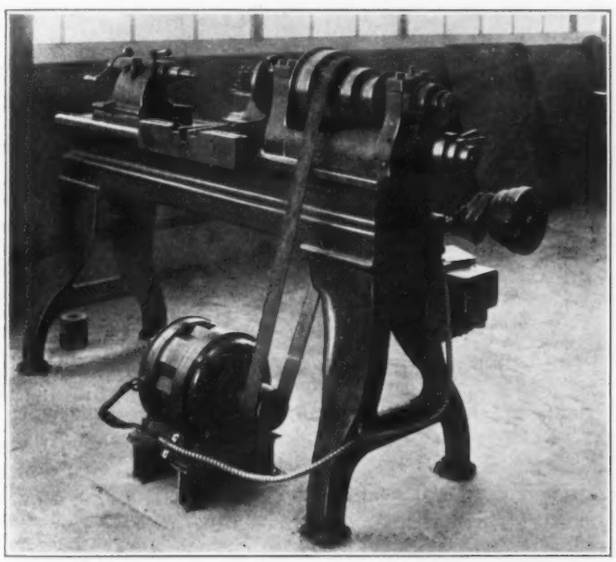
By extending the porcelain insulator of the new unit and flaring it at the bottom it is made to serve three purposes—those of insulator, reflector and socket holder. The design of the reflecting surface is said to be such that all the light from the lamp is sent down. Glare is eliminated by the use of bowl-frosted lamps so placed that the light source can be seen only against the white background of the porcelain reflecting surface. The globeless unit eliminates the initial expense of glass ball globes and the breakage in handling and operating. These factors and the utilization of one porcelain piece for both insulator and reflector give an added mechanical and dielectric strength. Moreover, the lamp support has a decidedly decorative appearance.

Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Lathes Changed from Group Drive to Individual Motor Drive

A LATHE originally designed for belt drive from countershafts above has been changed over to individual drive by a motor mounted on the floor in the factory of the Westinghouse Electric & Manufacturing



LATHE FRAME CUT AWAY TO ALLOW ROOM FOR BELT

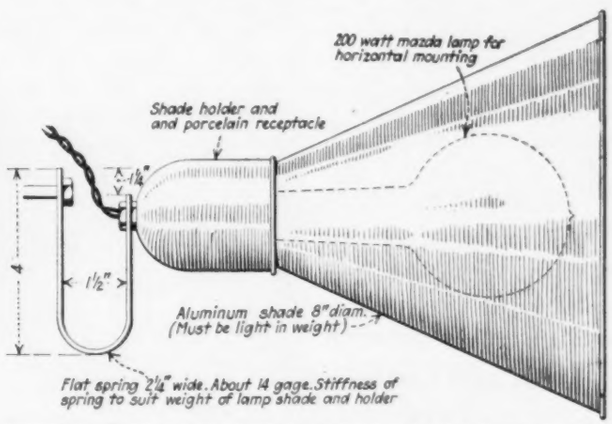
Company at East Springfield, Mass. As seen in the accompanying illustration, this 14-in. lathe is now driven by a 2-hp. motor mounted on two 4-in. I-beams bolted into the floor. To give clearance for the belt a portion of the frame of the lathe was cut away.

Boston, Mass. FIELD EDITOR ELECTRICAL WORLD.

Spot Lamp for Traveling Cranes

ONE of the greatest handicaps to the safe and speedy operation of a crane is poor light, especially in crowded mills and where the overhead clearance is slight. A craneman should be able to see his cables at all times in order that even a broken strand may be noticed and give warning of a weakening cable. He should be able to see the hook plainly and get a clear view of his trolley so that he will be able to get square over the "lift." It is necessary that he see the limit switch so as to prevent closing it and causing delay. A mill or factory may have a good overhead lighting system, but when the crane is directly over the load the bridge will cast a shadow.

Owing to excessive vibration causing breakages of lamps, there is usually no attempt to place them on the crane, the logical place for them. The accompanying diagram shows a spot lamp that throws its rays just where the craneman needs it and furnishes light for the "hookers up." It is mounted on the cage on a spring which prevents breakage from vibration. It can be made in a few minutes and is inexpensive. It should be attached through a switch and a fuse to the crane switchboard and mounted on the front corner of


200 watt mazda lamp for horizontal mounting
Shade holder and and porcelain receptacle
1¼"
4
1½"
Aluminum shade 8" diam. (Must be light in weight)
Flat spring 2¼" wide. About 14 gage. Stiffness of spring to suit weight of lamp shade and holder

SPRING PREVENTS BREAKAGE OF THIS LAMP MOUNTED ON CAGE OF TRAVELING CRANE

the cage near the bridge girder, using one of the bolts that fasten the cage to the bridge. If desired a bar of iron may be used to extend the lamp out between the girders but not far enough to be struck by the cables or hook. R. S. LOWRY.

Cambridge, Ohio.

Treating an Edison Battery that Has Decreased Output

AN EDISON battery should be taken out of service whenever it fails to give its normal amount of work. Even if it does not fall off greatly in output, it should be treated every ten months. When a battery is removed from service, after the cells are flushed or watered it should be given a two-hour charge so that the solution will be thoroughly mixed. Take off of charge and test the gravity of the cells with a hydrometer.

If a reading below 1.140 is obtained, the solution will have to be renewed. This is done as follows: Discharge the battery completely (until its voltage is zero) by short-circuiting it. Do not allow such a heavy current to flow that it will overheat the connectors. Then pour out about half of the solution, shake the rest vigorously and empty the cell; then immediately pour in Edison standard renewal solution. The proper height of the solution is ½ in. above the plate tops.

When the battery has been refilled connect up and charge for twelve hours at the normal rate of charge. The next step is to determine whether the output of the battery is normal. Connect it across a suitable resistance that can be adjusted for the various steps needed

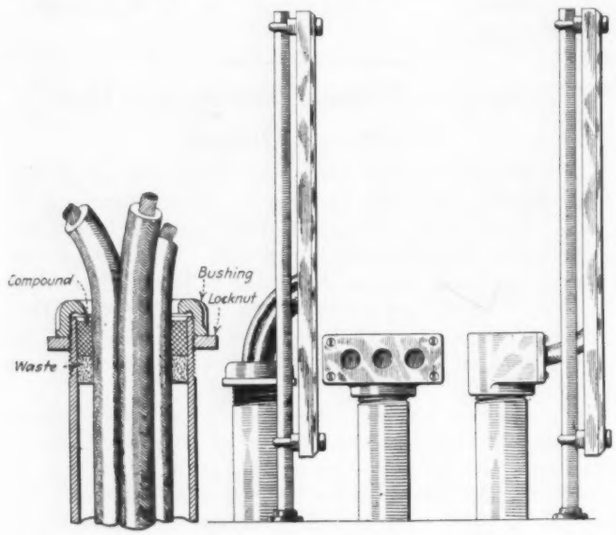
and insert an ammeter in series with it. Then close the circuit and set the rheostat to give the same current as the normal charging one. Discharge the battery at this rate for five consecutive hours. Each individual cell should be tested with a low-reading voltmeter at the beginning of the discharge and at the end of each hour. At the fifth hour each cell should have a voltage of 1, though as low as 0.97 volt is possible.

If there are any reversed cells, they should be removed and returned to the battery manufacturer for repairs, as such a reading indicates an internal short circuit. Any cell which has dropped below 0.97 volt but has a positive voltage (not reversed) can in the majority of cases be brought up in voltage by the following procedure: Remove the cell from the battery; charge fifteen hours at normal rate and discharge at normal rate to 0.5 volt; charge twelve hours at normal rate and discharge at normal rate to 1 volt; charge seven hours at normal rate and discharge at normal rate to 0.5 volt; charge twelve hours at normal rate and then discharge at normal rate for five consecutive hours and take the readings as before. This should bring the cell back to its normal rated capacity.

FRED A. REIBERT,
Foreman of Battery-Repair Department.
American Railway Express Company,
New York, N. Y.

Neat and Economical Large-Conduit Terminal Saves Space

FOR terminating runs of conduit in sizes above 2½ in. a construction which requires little space and economizes in material cost and labor has been employed by the writer. The accompanying drawing shows the scheme as applied to ore bridges where there is much vibration. Where there is little vibration the



SPACE SAVED BY ENDING CONDUIT RUN IN THIS MANNER

compound and waste may be omitted. If the compound is used, some means must be provided to allow the escape of the moisture of condensation. If the conduit runs continually down grade and its end may be left open, no special precaution is necessary. If, however, there is a low point from which moisture cannot run out, a small opening should be made at this point.

This conduit terminal does not require the room required for the ordinary conduit fitting employed for this purpose. When such a fitting is used, for instance, behind a switchboard where space is limited the conduit must often be brought up to a foot or more away from the panel to allow the fitting to be turned on or off the conduit. Furthermore, the fittings take up considerable space sideways and thus prevent placing the conduits close together. By bringing the wire out straight through a bushing and a lock-nut space and labor are saved and the resulting appearance is better.

Chicago, Ill. THOMAS NAF.

Requirements of Insulating Material in Motor Service

THERE are certain fundamental characteristics that insulations must have if they are to meet the operating requirements of motor service. While tests to determine these characteristics appeal particularly to motor designers, they should also be of interest to repairmen because they give about the best idea of what duty insulations must withstand and thus enable better selection and application.

The following characteristics are particularly important: Dielectric strength, mechanical strength, flexibility, susceptibility to acid, oil, moisture and heat; ability to conduct and radiate heat, cementing and sticking qualities, and finish. It is difficult to obtain any one insulation which ranks high in all these characteristics; hence a combination of treated and composite materials is usually required.

Some of the most important tests which experience has shown are essential and required on this variety of insulating materials will be given to show the refinement necessary in order to produce a motor correctly insulated that will finally pass the specified factory tests and at the same time stand up under the severe operating conditions to which it is subjected in service. These are outlined in the tabulation on page 1433.

To test the mechanical strength of cords, untreated and treated tapes and cloths to insure the selection of good strong materials that will stand the pull exerted by the workman, when these materials are being wrapped in place on the armature or field coils, the

TEST MADE ON FIVE SAMPLES OF CAMBRIC, SHOWING BREAKING STRENGTH

	1 Lb.	2 Lb.	3 Lb.	4 Lb.	5 Lb.	
Warp—50	52	49	41	42	=	45 lb. average
Woof—22	27	24	31	29	=	27 lb. average

tensile test is used. The materials tested are cotton, tape, cotton sleeving, surgical tape, gray webbing, drilling, treated cloth, friction tape, friction cloth, treated duck, torpedo twine, jute rope and linen twine. One type of apparatus used in making this test is an automatic power cloth tester having a capacity ranging from 50 lb. to 300 lb. Specimens of cloth are cut 1 in. wide and about 6 in. long, while samples of tape and cord are cut 6 in. in length.

The test strip of sample material is clamped in the jaws of the testing machine, which are 2 in. apart, and power is applied through a motor-driven worm. The pull or breaking point in pounds is registered on an indicating scale attached to the upper clamping jaw of the machine. Tests are made on a number of samples and an average value is taken as the final result.

The warp represents the thread running lengthwise in a woven material, while the woof is the name given to the threads carried by the shuttle; *i.e.*, those running crosswise in the fabric.

To determine the comparative strength of the various papers used for winding cells, U-pieces and for foundations for built-up mica wrappers, etc., a rupture test is used. The apparatus used is a Mullen testing machine having a capacity of 100 lb. pressure. The test specimens are cut 3 in. square from the commercial rolls of paper. The test piece of paper is clamped in the machine over a plunger which is forced up against it by means of a hand-operated pump. When the paper is ruptured the gage pressure is read and recorded. Fish paper such as is ordinarily used in built-up mica wrappers shows a rupture test of about 40 lb.

An air porosity test is made to determine the degree of porosity of paper used in making micarta insulating material. During the process of manufacturing this material it is necessary to select a paper that will take up a certain definite amount of shellac during the treatment process.

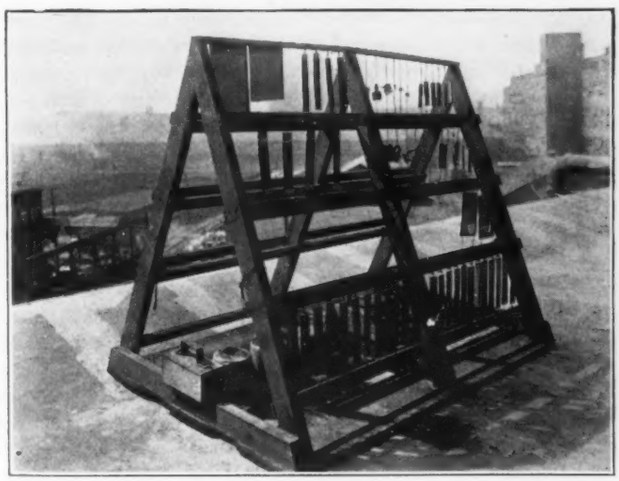
To test the strength of the cements used in connection with the construction of a direct-current motor a pulling test has been found practicable. These cements, which are used primarily in back of the commutator neck to seal up the openings around the windings, are put in place in a plastic condition and allowed to harden.

A destruction test is made to determine the durability of the rubber bushings used to protect the motor-lead cables where they come out through the frame of the motor. It is important that these bushings shall not break down mechanically owing to the strains and vibrations to which they are subjected in service. The apparatus used is a special intermittent compression testing machine.

To determine the softening at different temperatures of insulating gums such as are used in impregnating motor field coils, a drop-point test is used. In connection with this work it is important to use a grade of gum that will not soften and run out of the windings under the most severe operating conditions of the motor.

The test cup for determining the dielectric strength of varnishes is adjusted by spacing the electrodes $\frac{1}{10}$ in. apart. The cup after being carefully cleaned, using benzine or gasoline, is filled with the test varnish to within $\frac{1}{2}$ in. of the top. After being filled it is allowed to stand until all air bubbles have disappeared. The terminals of the testing circuit are connected to the binding posts on the test cup, and the voltage is applied first at a low value and increased at the rate of 3,000 volts per second until the oil in the cup is punctured and a breakdown occurs. During the test the temperature of the varnish is kept at from 20 deg. to 25 deg. C. Five tests are made on the sample varnish, and the average of these five voltage readings is recorded as the dielectric strength of the varnish.

An aging test is made to determine the ability of a varnish to retain its flexibility under the action of continued heat such as is found in a motor in service. It is important that the materials treated with a varnish retain their flexibility under these conditions; otherwise the continued jars and vibrations will crack it and destroy its insulating value. To make this test the only apparatus required is a suitable baking oven fitted with a high-reading thermometer or an indicating or recording pyrometer. The test specimens consist of



INSULATING TESTS GIVE AN INDICATION OF MATERIAL CHARACTERISTICS

On the left are shown weather-test rods where the action of the weather on paints and insulating varnishes may be noted. Acid, alkali and salt-water tests are made as shown in the center view. Liquid insulating materials are tested in the same way as the more familiar oil-test method. The test cup is adjusted by spacing the electrodes $\frac{1}{10}$ in. apart.

strips of sample cloth cut 6 in. x 3 in., which are given several dippings of the varnish to be tested. A space is left untreated at the top of the samples to record the test data.

Four samples are prepared as outlined above and placed in an oven which is maintained at a temperature of 100 deg. C. The samples are removed as follows: One at end of 100 hours, two at end of 200 hours, three at end of 250 hours, four at end of 300 hours.

These samples are then tested by folding or bending over rods of different diameters and noting the smallest diameter around which they may be formed without cracking. A test specimen, after baking 300 hours at 100 deg. C., which can be taken at room temperature and folded and creased without showing any indications of cracking is considered very satisfactory.

In the operation of motors, owing to carelessness and in some cases to too frequent oiling of the bearings, excess oil finds its way inside the motor frames. It is important that the varnish used for insulating purposes should not be affected by this oil, and to this end it is advisable to use an oil-proof grade of varnish.

CLASSIFICATION OF INSULATING MATERIALS AND TEST USED TO DETERMINE PROPER CHARACTERISTICS

Insulating Materials	*Tests*
LIQUIDS:	ON UNTREATED MATERIALS:
Amber insulator	Tensile test
Plastic insulator	Rupture test
Asphaltum varnish	Air porosity test
Insulating varnish	Pulling test
Shellac	Destruction test
PAPERS:	Creepage test
Untreated—	ON MATERIALS USED IN TREATING:
Fish paper	Drop-point test
Asbestos	Viscosity test
Fullerboard	Dielectric test—liquid insulating materials
Cement paper	Penetration test
Treated—	Aging test
Micarta	Oil-proof test
Japanese paper and mica	Acid, alkali and salt-water test
Mica tape	Cementing and sticking qualities
Fish paper and mica	Heat conduction and radiation tests
CLOTHS:	Baking or drying qualities
Untreated—	Weather test
Cotton tape	ON TREATED AND COMPOSITE MATERIALS:
Cotton sleeving	Adhesion test
Surgical braid	Slip test
Gray webbing	Treating test specimens
Drilling	Dielectric test, sheet-insulating materials
Treated—	Moisture absorption test
Treated cloth	Gaging built-up mica board
Friction tape	Dielectric test, built-up mica and paper
Friction cloth	Experimental treating tower
Treated duck	
CORDS:	
Torpedo twine	
Jute rope	
Linen twine	
SOLIDS:	
Mica	
Porcelain	
Rubber bushings	
Impregnating gum	
Cement	

Samples of cloth are prepared similar to those used in connection with the aging test, and after being thoroughly baked, they are placed in a mineral oil bath, which is held at a temperature of approximately 60 deg. C. for several days. If the varnish on the treated samples shows no signs of softening or becoming tacky, this is an indication that it is proof against the action of the oil. A similar test can be quickly made on the baked treated samples of cloth by rubbing them with oily waste. Under these conditions, if the varnish is oil-proof, it will not soften and cannot be rubbed off the surface of the cloth.

A test is made on insulating varnishes used in treating coils, etc., to determine their ability to withstand the action of acids, alkali and salt water. A large rectangular glass jar fitted with a wood rack, a number of metal test rods and a testing circuit with a light in series is arranged as shown in the illustration. Test specimens consist of $\frac{3}{8}$-in. round steel rods 12 in. long, well rounded at the lower end, which receive a uniform coating of varnish $2\frac{1}{2}$ mils thick baked on the entire surface within several inches of the top of the test rod. In preparing these test specimens the bare rods are first thoroughly cleaned and dipped in the sample of varnish and baked. This operation is repeated not less than three times, and sometimes more, depending upon the fluidity of the varnish, in order to get the desired $2\frac{1}{2}$ mils thickness of film which is specified for this test.

The treated test rods are placed in the rack, which insulates individual rods, and are then suspended in the acid, alkali or salt-water solution contained in the glass jar. During the first four hours of the test an alternating current from a 110-volt circuit with a light in series is applied every fifteen minutes through the terminals, one of which is connected to the liquid solution and the other applied to the individual test rods for a short interval to locate any breakdowns. After this set of short-time readings is taken, similar tests are made each morning and evening until the insulation breaks down or the test has run its specified time limit. In connection with these tests either a saturated-acid, an alkaline or a salt-water solution is used, depending upon the nature of the test. The final results are represented by the average on three test rods of each grade of varnish. The amber insulator used in connection with the dipping and baking of motor armatures when tested under the above conditions shows an average of 880 hours in a saturated solution of salt water.

It is necessary to know something about the time and temperature required thoroughly to dry or bake out the insulating varnish in order to get the best results with the least possible delay to production. Samples of cloth or tin are dipped in the air-drying varnish and hung up in the open and the time required to dry is noted and recorded. In testing the baking varnishes the test samples after being dipped in the varnish are placed in the oven and baked at a constant temperature for a definite period of time until thoroughly dried. The temperature is then increased and the time noted. In this manner a number of tests are made with varying temperatures through a range of from 90 deg. to 120 deg. C., noting the time required to bake thoroughly. The maximum temperature which will not damage the texture of paper or cloth to be treated is taken, as this increased temperature will expedite the production in the factory.

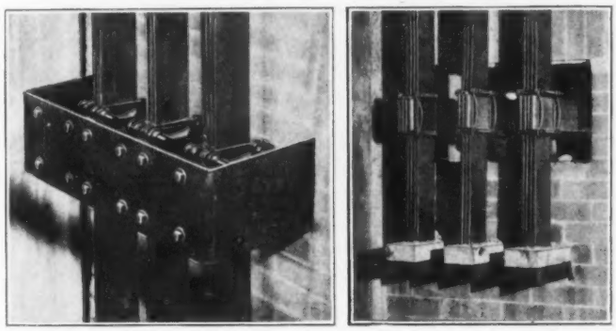
It is very important to know just how certain paints and varnishes resist the action of weather under varying conditions, and to determine this a weather rack, such as shown, has been constructed and placed on the roof of one of the shop buildings. On this rack the various treated samples are securely suspended and exposed to all weather conditions over a long period of time, and they are carefully inspected at stated intervals of time to determine their deterioration. These observations are recorded and comparisons made of the condition of the various samples of paints and varnishes under test.

The entire list of tests given in the tabulation may thus be carried out, but the few given are indicative of the methods used.

JOHN S. DEAN,
Railway Motor Engineering Department.
Westinghouse Electric & Manufacturing Company,
East Pittsburgh, Pa.

Method of Supporting Vertical Run of Very Heavy Bus

SUPPORTING a 70-ft. vertical run of three copper busbars, each made of three ¼-in. x 4-in. strips, was one of the problems met in designing the electrical system for the Famous Players-Lasky motion-picture studio in Long Island City, N. Y. The great weight of these buses is carried by special wrought-iron supports attached to the wall at 6-ft. intervals. Heavy insulators at the base also assist in absorbing the vertical thrust. As may be seen from the illustration, each support is made of 10-in. x ½-in. wrought iron bent in the form of a U 20 in. wide and extending out from the wall 14 in. To this are fastened three Engineering Equipment Company common busbar-type insulators spaced 6 in. on centers. The U-shaped supports are attached to the wall by a number of anchor bolts on each side. At the bottom end of the buses are porcelain heel plates 3 in. wide, 2 in. thick and 8 in. long.



VERTICAL BUS RUN BRACED AT INTERMEDIATE POINTS AS SHOWN ON LEFT AND SUPPORTED AT BOTTOM BY PORCELAIN HEEL PLATES

These heel plates are supported by 3-in. channel irons embedded deeply into the wall.

Usually in the case of long runs of busbars provision is made for expansion bends to take up the longitudinal movement of the bars, but this was not done at the Famous Players studio. Instead, the bars are held in the insulators in such a manner that they are free to slide back and forth. In addition to this the insulators themselves are slotted where they are fastened to the hangers, thus allowing the insulators a certain amount of travel. It was thought that by providing these two opportunities for the bars and their insulators to slide in the direction of the run there would be no need of expansion bends or similar provisions. Although the studio had been unheated during much of the winter, there was no evidence that the unusual amount of contraction was not adequately cared for by this system of support.

It had been calculated that the horizontal thrust strain on short circuit for this feeder system would be 409 lb. per foot with 8-in. centers between opposite polarities. The insulators within the wrought-iron braces must stand a short-circuit stress of 2,454 lb. each. For this reason they were tested at 4,100 lb. cantilever stress before installation.

At the top of the studio another set of open busbars runs across the building, and these are supported at 6-ft. intervals on heavy high-tension insulators. After completion, the entire busbar system was inclosed in a stout metal grid of fine mesh so that the feeders could not be short-circuited by tools or other objects falling across them.

In addition to the fact that this system requires no conduit, it also permits of heavier loading because of the greater radiation obtained by the laminated construction and at the same time permits easier and more frequent inspection throughout its entire length.

Famous Players-Lasky Studio, E. L. BRAGDON.
Long Island City, N. Y.

Eliminating Brush Trouble on a 500-Volt Motor

A MOTOR of 5 hp., 500 volts, had been blowing fuses quite frequently when the writer was called upon to remedy the trouble. The brushes were found to be tight in the holders, preventing them from making good contact, thereby causing sparking, which in turn caused frequent flashovers. Accordingly the commutator was turned and a new set of graphite brushes with shunts were installed of the same kind as those which had been used before.

However, these brushes sparked badly and sparks traveled around the commutator. Wiping the commutator would temporarily relieve this condition, but at every application of the load the brushes would spark, and also when the main line switch was opened the field discharge would cause a bad spark of short duration. Thinking that this trouble was due to the brushes being too soft and having the wrong contact resistance, a harder brush was tried. As a result sparking disappeared.

A. HERVEY.
New York City.

Self-Starting Synchronous Motor

A SYNCHRONOUS motor which will start and come up to speed under load was developed recently. It makes use of a new principle of design in a squirrel-cage starting winding. For this winding copper or brass tubing is used, instead of solid bars. Obviously the outer diameter may remain the same for all standard designs, this feature in connection with standard manufacture eliminating the necessity of using various index dies for the pole punchings. The resistance, however, of the tubular conductor may be varied over a wide range by changing the wall thickness of the tubing. Inside of this tubing are embedded conductors of magnetic material, such as iron or steel. The bars are fastened to end-ring segments, which also serve as upper coil supports for the field coils. These end-ring segments, forming a continuous ring, are connected together between poles by the use of a split sleeve which fits into holes drilled on the job when the poles are assembled. A taper pin is driven in to insure contact and mechanical stability.

At starting the frequency in the squirrel-cage winding is the same as in the line, but as the rotor comes up to speed the frequency will fall off to zero. Owing to the skin effect the inner bars of magnetic material will not be effective at starting, but a high starting torque is established if the copper or brass tubing has the proper resistance. As the rotor, however, is accelerating, the inner conductors will become effective and in the neighborhood of synchronous speed will furnish a high pull-in torque in addition to the rather small torque furnished by the tubing at that speed. It is possible by changing the squirrel-cage winding to make the torque characteristics adapt themselves to various applications of synchronous motors.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

House-Wiring Growth Featured at Boston Show

A FULL-FLEDGED company office, where applications for lighting service were received, was a feature of the exhibit of the Edison Electric Illuminating Company of Boston at the Boston "Home Beautiful" Show, open from April 16 to 30 inclusive, in the Mechanics' Building. Leading distributers of domestic lighting, heating and power equipment co-operated to

OFFICE OF BOSTON EDISON COMPANY AT "HOME BEAUTIFUL" SHOW

mass the more prominent electric exhibits in the central portion of the hall.

An interesting feature of the Boston Edison exhibit was two charts showing the growth of house wiring in the company's territory since 1912. In that year only 15,000 houses were wired out of 128,000, whereas in 1920 60,000 out of 165,000 had been wired. The other chart showed that from an extended analysis of Boston Edison customers' bills $2.33 per month is the average

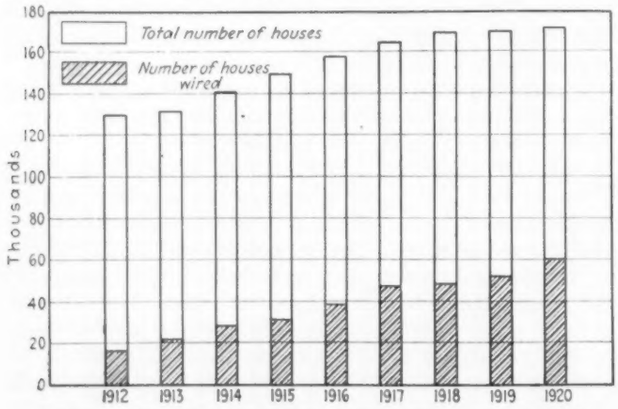
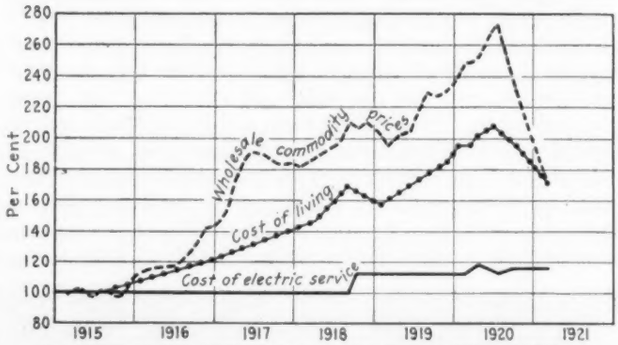


CHART SHOWING GROWTH OF HOUSE WIRING SINCE 1912



COMPARISON OF INCREASE IN COST OF ELECTRIC SERVICE AND INCREASED LIVING COST

cost of electric service in the average apartment and that $4 per month is the average cost of all dwelling-house use. These figures were based on a study of more than 73,000 houses and apartments, housing 400,000 people. The diagram shows that electric service now costs only about 18 per cent above the pre-war rates against a 75 per cent increase in the cost of living, and that electric rates increased only 20 per cent maximum against a 108 per cent cost of living increase in the summer of 1920.

Promoting a Good Understanding Between Utilities and People

IN THE forceful address delivered at the N. E. L. A. convention in Chicago by E. I. Lewis, formerly chairman of the Indiana Public Service Commission and now a member of the Interstate Commerce Commission, on the mutual obligations of the utilities and the public, he counseled the utilities to educate public opinion to the true conditions of the utilities, to discontinue all practices which are subject to legitimate criticism and to stop dodging responsibility.

Reviewing the many obstinate problems which confront the industry, he pointed out that utility rates as a whole have not advanced comparably with other commodity prices and that therefore a reduction to pre-war levels could not be expected. Continuing, he said:

"Another reason for failure of public utility rates to drop is that the utilities were called on to keep up with the abnormal war growth and expansion of cities and industry and with the extravagances of the individual citizens. The plants are there with their financial obligations incurred at a time when the cost of such incurrence was at its height. They are ready to serve the 1917-1920 volume of business. But the business and convenience whose demand was so insistent are temporarily gone or less active. There is a shrinkage in revenues, but no corresponding shrinkage in fixed obligations, overhead or even in operating expenses.

"Then the drop in operating costs, so far as public utilities are concerned, has been more apparent than

real. Then, too, there are taxes. Though public utilities constitute the only business of which I know whose operating sheets do not record payment of excess profit taxes during the war, they are bowed under the steadily accumulating burden of local taxation.

"Now, when utility rates were weakly trailing far behind ascending commodity prices, the public could easily understand the relation between cause and result. It must be admitted that formerly the public did not show very vital concern in such small items as utility rates. But it is different now. Business served by public utilities has been hit; there is some unemployment; wages are beginning to descend; some commodities have hit pre-war levels. People are beginning to scrutinize and to count cost. They do not understand these more or less intricate conditions which result in utility rates failing to respond to the downward readjustment. Too, the public attitude is less broad. There is a disposition to criticise, and to raise false issues."

Utility Situation Changed

Mr. Lewis then spoke of the change in the whole utility situation brought about by the war and of the new and difficult position in which regulatory commissions have been placed by the need to increase rather than to reduce rates. Regulation, he said, faces a most critical period. He went on:

"There is now a most compelling necessity that public utilities relieve regulatory bodies of some of the tremendous pressure falling upon them by reason of this new state of affairs. This the utilities can do in three ways:

"1. By educating public opinion to the true condition of the utilities and by taking that public into their confidence by placing all of their cards face up on the table.

"2. By removing all features of their business which are subject to legitimate criticism by the public and by going more than half way to conciliate public opinion.

"3. By stopping some utilities' practice of dodging responsibility and of 'passing the buck' to the commissions in matters in which the responsibility lies entirely in the utility."

He contrasted purely municipal enterprises such as fire protection, police protection, schools, roads and so forth with utility service and showed how much more important the latter is than the former.

"When we gain a clear understanding of what public utilities are," he said, "we must then get as clear an understanding that if these great services of modern city life are starved, they cannot perform reliable service, and also an understanding of the incomparably greater costs of cheap, poor service than of properly sustained good service. Then let the city get a clear understanding of the unescapable fact that cities can grow and expand only as these, their great servants, are able to command the credit necessary to enable them to contract for capital to meet that growth and expansion.

"Let the city also face these conditions: That there has grown up a sentimental prejudice—on a considerable foundation of objections to the attitude of communities toward public utilities—against investment in public utilities, and that the difficulties and costs of contracting for this needed capital are now increased by all nations and governments, even down to the local townships, and cities owning their own utilities, frantically bidding unheard-of prices for money and offering tax-exemption bonuses.

"Let us all get a clear understanding that there has to be a broadening of view and policies to such an extent that regulation will provide utilities with liberal margins of cash working capital that will permit adequate storage of coal, and also with cash surplus, fat, well invested and quickly convertible, that can be drawn on to bridge temporary sags in revenue or to meet calamities, without that recourse to rate adjustments which is the necessity of utilities that are held to the bare existence which inspires fear of any prospective change.

Nothing So Expensive as Cheap, Poor Service

"There must be an understanding on the part of industry, now so generally served by the public utilities, that it must pay a rate for power that will approximate the value of the service, that the old days of bleeding central-station companies white and leaving losses to be carried by higher rates paid by smaller consumers are certainly well at an end. Particularly, let these industrial patrons understand that nothing is so expensive as poor and unreliable service and nothing so short-sighted on their part as a policy of utility starvation which will certainly kill an industrial community and individual industries.

"Let the utilities thoroughly understand that they are public servants; that good will, good public relations, are to be acquired not alone by good service but by frankness and an every-day policy of treating even the smallest of their patrons with that consideration which is practiced by successful business in non-regulated fields.

"The public must acquire an inkling of understanding that public utilities, whether they be privately or municipally owned, are not philanthropies; that they operate with costly materials and have heavy wage rolls and heavy investment obligations; that nothing short of real money, and a certainty of it, will satisfy the tax collector, those who furnish coal and supplies, the laborer and the much-courted investor.

Rates Based on Fair Valuation

"Let there be a clear understanding on the part of all that the day has passed, under public utility regulation, when the amount of stocks, bonds and other evidences of indebtedness outstanding are determinative of the rates to be charged; that the rate is built on an ascertained fair valuation irrespective of securities; that the public, having rightfully demanded such a basis, has on it a moral obligation of adequate maintenance, replacement and return on that property dedicated to the public use; that repudiation of that obligation brings disaster not alone to the utility but to the community.

"Let there be a full and frank understanding that on such basic conditions as have been enumerated is built the policy—the very best system known up to the present—of public utility regulation, which is primarily designed not for the utilities or those served, but for promoting and extending public welfare.

"Finally, let there be a clear understanding that the disturbance of a good code of relations between those served and the servants—and this code is undergoing unusually severe strains—would, in the absence of substitution of another adequate system, throw the utility situation into chaos and create a condition that would be highly detrimental to local welfare and demoralizing nationally to an extent little comprehended."

Southern California Edison Distributes $6,634,800 Stock in Four Months

IMMEDIATELY following authorization of the California Railroad Commission for the sale of an additional $10,000,000 par value of its common capital stock, the Southern California Edison Company, on Jan. 24 of this year, resumed its campaign to distribute its stock among the people in the territory served. In a period of exactly four months, down to May 24, the total sales reached the high figure of $6,634,800 par value to 8,823 subscribers, which is an average of seven and one-half shares, or $750 par value, purchased by each subscriber. The campaign is actively continuing and being handled entirely through the company's organization with its 5,200 employees. To each geographic district and each department quotas have been allotted, with the result that keen friendly competition prevails and all employees are stock salesmen. Incidentally, several prizes for best results have been offered and a small commission is allowed employees for sales, but, according to A. N. Kemp, vice-president in charge of finance, these considerations are minor as compared with the spirit of constructive service which is behind the movement.

The company officials have been attending three or four evening meetings each week all through the territory where the company operates, encouraging the employees in their work and giving new thought and inspiration to the program.

"Realizing that the widest distribution of our stock can best be obtained by having a large number of our employees understandingly and enthusiastically working on stock sales," said Mr. Kemp, "we have been careful to explain thoroughly the need for power development and the benefits of customer-ownership. We all recognize that the proceeds from the sales of our stock go into new water-power development, increasing production, conserving the natural resources and encouraging thrift, and this has aroused a spirit of national patriotism among our forces. We know that the future growth and prosperity of our state depend upon rapid development of water power and that our community growth in Southern California and the San Joaquin Valley is being enhanced by the rapid increase along the lines of industrial and agricultural development, both absolutely dependent upon an adequate supply of water power. We all appreciate the added strength of the company's position in the territory it occupies which results from the wide distribution of its stock among the people at large throughout this territory. This stimulates a keen personal interest in the building up of our company's business, particularly among employee stockholders, who number more than 80 per cent of our employees.

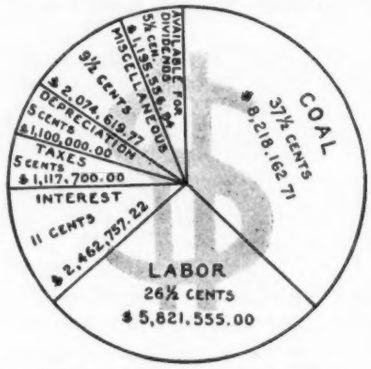
"The result of the large sales in the past four months has been to increase the number of the company's stockholders to 13,255, of whom more than 11,000 are in the territory served. This affords an interesting contrast to the number of stockholders in 1917 when we first undertook the distribution of our stock at home. At that time we had 1,864 stockholders, of whom only 600 were residents of Southern California. Among our present stockholders the company numbers 2,694 employees who are purchasing on an installment plan $4,927,700 par value of stock.

"Heretofore the primary aim of utilities desirous of placing their securities with the people in the territory served has been to sell stock, and the wide distribution of the stock has been of secondary importance. The Southern California Edison Company was probably the first in the country definitely to reverse this program and base its campaign on obtaining stockholders and more stockholders, with the result that the amount of stock sold took care of itself. Many of our railroads and industrial corporations number their shareholders by tens of thousands, and it is our ambition to put the Southern California Edison Company among the leaders in the number of stockholder partners."

How the Detroit Edison's Revenue Was Spent

TO SHOW how its 1920 gross revenue was spent the Detroit Edison Company recently issued the accompanying chart with the following interesting analysis of the expenditures:

The revenue received by the company in 1920 amounted to $21,990,351.64—quite a sizable sum—but, after all, to most mortals not much more than a row of figures. The brain does not readily wrap itself around a million and absorb its meaning. For the purpose of this little story, therefore, let us make believe, as the children say, that the entire revenue of last year was shrunk to the dimensions and value of one of those big, opulent looking silver dollars that used to weight our pockets—and see how it was split up.



HOW EACH DOLLAR WAS SPENT

Taking the items of expenditure in the order of their magnitude, it will be seen that coal, in spite of its poor quality and bad behavior last year, demanded the largest share, grabbing off 37½ cents ($8,218,162) as against $4,642,789 in 1919, or an increase of 77 per cent.

The next largest item is labor, which received 26½ cents of the fast-diminishing dollar ($5,821,550) as against $3,894,175 in 1919, or an increase of 49 per cent.

Our dollar has now been whittled down to 36 cents, and there are still a lot of things to come out of it. Interest on the company's borrowings (funded and unfunded debt) must be paid, or the wheels will no longer go round. This obligation took 11 cents more; and taxes, that twin brother of death, neither of them to be dodged, would not be satisfied with less than 5 cents.

All that is now left of our once impressive looking dollar is 20 cents—and still they come, these hungry items. "Miscellaneous," for example, a blanket term covering a large family of expenses—rentals, adjustments, discounts on bond sales, compensation for injuries, lamps and other things far too numerous for recital here. These took 9½ cents, leaving a remainder of but 10½ cents with which to make the necessary provision against depreciation of plant and for the payment of dividends to owners of the company's stock. As a matter of fact, this remainder was not sufficient to provide adequately for depreciation and for stockholders' dividends, and the slender surplus set aside in happier years for emergencies was drawn upon to make up the deficiency of 1920.

It is interesting as well as painful to observe the steady ascent of operating expenses in the past few years—from the year we entered the war. In 1916 these expenses took 54.5 cents of every dollar received; in 1917, 63.8 cents; in 1918, 67.2 cents; in 1919, 68.9 cents, and in 1920, 77.6 cents. One may hope the peak is reached and that so-called "normalcy" will be gradually restored, but who can tell?

Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Motors, Generators and Transformers

Circle Diagram of the Repulsion Motor—E. SIEGEL.—The characteristics of a repulsion motor may be plainly shown graphically on a specially developed circle diagram giving stator current, phase angle, torque, output, speed and rotor current. To each possible brush angle a certain diagram circle corresponds. The characteristic points of the repulsion motor (short-circuit point, synchronism point and no-load point) describe circles at the varying brush angles, the positions of which are given definitely by the amount and phase of the current flowing into the stator at the no-load position of the brushes ($\beta = 90$ deg.) and the short-circuit position of the brushes ($\beta = 0$ deg.). These two currents being known, it is easily possible to draw the complete diagram, giving all the above-mentioned characteristics.—*Elektrotechnik und Maschinenbau*, April 24 and May 1, 1921.

Generation, Transmission and Distribution

Generating System of the West Penn Power Company.—G. G. BELL.—A discussion of engineering features and economies in power-plant design and operation as worked out for the system of the West Penn Power Company.—*Electric Journal*, May, 1921.

Calculation of Pins for Pin-Type Insulators.—M. DONATH.—The author has developed a very exact method of calculating the most favorable shape and cross-section of shanks for the support of pin-type insulators, and the results have been incorporated in the standardization rules for overhead line construction. Full mathematical derivations are given with practical examples. — *Elektrotechnische Zeitschrift*, April 28, 1921.

Keeping Steam-Turbine Lubricating Oil in Good Condition.—CHARLES H. BROMLEY.—The author reviews the severe conditions that have to be contended with in steam-turbine bearings. No satisfactory lubricant has been found which will not deteriorate with continuous use without purification, he says. The various processes employed for removal of sediment and moisture are described and a list of the requirements of an efficient oil filtration system is given.—*General Electric Review*, May, 1921.

Hydro-Electric Plant on the Arly at Ugine.—F. BABEY and P. GUIN.—This hydro-electric station in the Savoy, France, supplies the Paul Girod iron and steel works, employing about 2,500 men. The main energy consumers are six furnaces of 20 tons to 25 tons, one 6-ton and four 2½-ton Girod furnaces. A head of 19 m. is utilized in nine units of 600 hp. each, seven units of 300 hp. each and one unit of 2,000 hp. A second plant, further down the river, also uses a head of 19 m. and generates 1,200 hp. in two units of 600 hp. each. All turbines are of the horizontal-shaft type. The sections of one of the 600-hp. turbines and one generator are given. Very few electrical data are contained in the article—*L'Electricien*, April 15, 1921.

Development and Speed Regulation of Hydraulic Turbines.—M. EYDOUX.—An interesting article describing and criticising a number of existing hydraulic turbines of the Pelton and Francis types. It contains very useful assembly drawings of a 16,000-hp. double-nozzle Pelton wheel, a 3,000-hp. quadruple-runner Francis turbine with horizontal shaft, a 12,000-hp. slow-speed vertical-shaft American turbine and a 3,800-hp. high-speed vertical-shaft turbine.—*Revue Générale de l'Electricité*, April 30, 1921.

Traction

Diagram of Vibration Phenomena of Electric Locomotives with Rod Drive.—A. WICHERT.—A special registering apparatus was built to plot simultaneously the revolutions of the wheel per minute, the time and the torsion vibrations of the armature of a locomotive. This instrument was properly installed upon a 1-C-1 passenger-type locomotive driven by one 16⅔-cycle alternating-current motor. The author reproduces the complete diagram and explains it step by step, showing how perfectly this actual test proves his theories on vibrations laid down six years ago. As vibration must be expected on all locomotives with rod drives, he suggests making similar graphic investigations for all types, which will throw light on many an otherwise mystifying problem. The author does not give a description of the recording instrument.—*Elektrotechnische Zeitschrift*, April 28, 1921.

Installations, Systems and Appliances

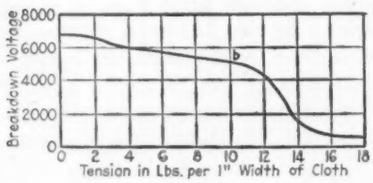
Operating Safety of Fuses.—W. HOPP.—This paper gives the results of a great number of tests made on different makes of fuse plugs and fuse cartridges. The operation of fuses in series and in parallel is discussed, and the different behavior of fuses in direct-current and in alternating-current lines is shown graphically. The author emphasizes the fact that it is extremely difficult to build a safe and uniform 500-volt fuse for more than 6 amp. Very elaborate manufacturing and testing facilities are required to be sure of a reliable and uniform product. Some theoretical considerations of the circuit-opening phenomena of fuses are given which might bear further investigation. Finally some technical data are offered for such important details as the proper fastening of the fuse wire to the contacts, influence of the size of the fuse wire and the contact resistance of the plugs and cartridges. This is a very useful article on a subject which is rarely dealt with in electrical literature.—*Elektrotechnische Zeitschrift*, May 5, 1921.

Overvoltage Protection in Theory and Practice.—W. PREHM.—Properly dimensioned and well-located condensers are frequently used for the protection of high-voltage networks against overvoltages and line surges. The author has conducted a long series of very exacting laboratory and actual line tests with condensers in connection with switches, transformers and cables and

has found that the customary use of condensers always introduces trouble rather than protection. For all laboratory tests a 15,000-volt, 7.5-kva. oil-immersed transformer was used. The existence and magnitude of excess voltages were determined with needle-point spark gaps. Line disturbances were caused by repeatedly opened and closed disconnecting switches. Eighteen main groups of tests were made, both for single-phase and three-phase systems. In every case the addition of condensers either caused or increased existing surges. A series of interesting tests was made on a 16-kva., 15,000-volt transformer to show how the dangerous discharge waves from a condenser affect the different parts (coil sections) of its windings. Curves plotted along the diagram of the winding as abscissas showed triple voltages on the end coils. Concluding, the author sounds a general warning against any use of condensers as possible line protectors.—*Elektrotecknische Zeitschrift*, April 21, 1921.

Electrophysics and Magnetism

Industrial Research Work on Insulating Materials.—The work of a committee representing British industries on the effect of testing the insulation of varnished cloth and varnished silk, adhesive tape and varnished paper is dealt with. In the accompanying curve it is shown that varnished cloth, commonly known as "Empire cloth," is not seriously affected under tension until the point *b* is reached, at which the elastic limit of the varnished film is approached, with consequent rapid deterioration thereafter.—London *Engineering*, April 22, 1921.



EFFECT OF MECHANICAL TENSION ON THE VOLTAGE BREAKDOWN OF VARNISHED CLOTH

Electrochemistry and Batteries

Ductile Electrolytic Nickel.—CHARLES P. MADSEN.—An outline of the experimental work on the electrolytes, cathodes and anodes leading to the production of electrolytic nickel of greatly improved mechanical properties.—*Chemical and Metallurgical Engineering*, May 25, 1921.

Units, Measurements and Instruments

Null-Deflection Constant-Current Type of Hot-Wire Anemometer.—J. S. G. THOMAS.—The laws governing the convection of heat from fine heated wires are such as to indicate the hot-wire anemometer as pre-eminently the type of instrument to be employed in the investigation of slow rates of flow of gases. Employing the Morris type of hot-wire anemometer in such investigations, difficulties are encountered owing to the existence of the free convection current arising from the heated wire. The author discusses the type of directional hot-wire anemometer, in which these difficulties are largely obviated and by the use of which the range of application of the hot-wire anemometer may be extended to the investigation of very slow-moving streams of gas.—*Philosophical Magazine*, May, 1921.

A Microphone "Stethoscope" for Bearings.—A device in which a microphone is substituted for the rod frequently used for detecting abnormal noises in moving machinery. The condition of bearings and gears can, according to this article, be ascertained without requiring the observer to leave his office.—London *Engineering*, May 6, 1921.

Telegraph, Telephony and Signals

Submarine Cable to East Prussia.—E. MULLER.—East Prussia has been separated from the German mainland by a wedge-shaped territory assigned to Poland. To obviate international difficulties from overland telegraph and telephone lines, Germany decided to lay a submarine cable, bridging by sea the Polish wedge. This is the longest submarine telephone cable in existence, having a length of 170 km. The cable contains six telephone pairs and three single telegraph wires. Each of the twelve telephone wires is covered with a double layer of annealed iron wire. All conductors are paper-insulated. Owing to a depth reaching 110 m. at its greatest point a double lead sheath, a double spiral of steel wire and finally an outer interlocked steel armoring have been used. Each 1½ miles (2.4 km.) a water stop has been built into the cable to localize any entrance of water into the cable in case of break. The over-all diameter of the submarine cable is about 2 in. (52 mm.), and its weight is 8 lb. per foot (11 kg. per meter). The manufacturers delivered the cable in three lengths (21 + 77 + 77 km.). A 1,000-ton freighter with a modern paying-out machine mounted on its stern was used and finished the work in two trips of sixteen and thirteen hours actual laying time. A sectional drawing of the exceptionally strong joint boxes used is given in the article. The required guarantee data for 1 km. of telephone (double) line, alternating current, 800 cycles and 15 deg. C., were: Effective resistance, 12 ohms; self-inductance, 0.009 henries; mutual capacity, 0.052 Mfd.; specific damping (β), 0.015; insulation resistance, 2,000 megohms. The required data for the telegraph wires for 1 km. at 15 deg. C. were: Direct-current resistance, 9.5 ohms.; capacity, 0.075 Mfd. (other lines grounded); insulation resistance, 2,000 megohms. The author gives a complete account of actual test methods and results obtained by the postal authorities at the final inspection. The telegraph lines operate with Siemens rapid telegraphs, and vacuum-tube amplifiers are used for the telephone lines. Wiring diagrams for both operations are given in full detail.—*Elektrotechnische Zeitschrift*, April 7 and 14, 1921.

Developments of Radio Communication in French Aviation—I.—M. BERNARD.—The author describes the different stages of the development of radio communication from and between airplanes. The first satisfactory operating set contained a spark coil fed from a 20-volt storage battery. Special attention had to be paid to the interrupter. Later the heavy storage battery was superseded by a small propeller-driven direct-current dynamo running at an average speed of 4,500 r.p.m., and delivering 20 volts at 5 amp. Finally two types of propeller-driven 900-cycle alternators were developed, differing only in weight and bulk from each other. Both are rated at 50 volts and 7 amp. at 4,500 r.p.m. The machines contain a direct-connected exciter and a toothed-wheel generator with no rotating windings. A ratio transformer with a ratio of 1 to 300 furnishes the necessary antenna current. A rotary spark gap mounted on the main generator shaft is used on both types.—*Radio Electricité*, April, 1921.

Scientific and Industrial Research

(PRINTED IN THE THIRD ISSUE OF EACH MONTH)

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available, and Suggestions for Co-operative Work.

Conducted by PROF. VLADIMIR KARAPETOFF
Cornell University, Ithaca, N. Y.

Research in Progress and Completed

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Digest of Electrical Literature" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

ARC LAMP, MAGNETITE.

Recent improvements in magnetite arc lamps have made it possible to reduce the wattage consumption, in the case of a 4-amp. lamp, from 320 watts to 270 watts. This gives a greater lamp capacity to a lighting circuit, allows new lamps to be put in existing systems without adding extra circuits, and results in reduced investment changes per lamp.—*N. E. L. A. Lamp Committee.*

ARC LAMP, MAGNETITE, ELECTRODES FOR.

An improvement in operation has been obtained as a result of the use of a flattened electrode which is interchangeable with an ordinary round-type electrode. The life of the electrode is increased by compounding the material under extremely high pressure so that more material can be packed into a given space. This increased density and uniformity of composition results also in greater uniformity of life and candlepower of the electrode.—*N. E. L. A. Lamp Committee.*

CORE LOSS AT LOW MAGNETIC DENSITIES.

In designing electrical apparatus in which a differential magnetic action of two windings is used, as in a differential transformer, it is sometimes of importance to know the core loss at very low magnetic densities. A ring was tested consisting of soft-iron wire, with two windings, at 50 cycles, within the limits of flux densities of from 27 to 127 gausses, and it was found that the loss increased as the flux density to the power of 2.19. A Rowland dynamometer wattmeter was used, the stationary coil of which was in the primary circuit and the movable coil in the secondary of the ring under test. The method is a combination of the methods used by the Bureau of Standards for steel testing and for measurement of dielectric losses.—*Boris Podolsky, University of Southern California, Los Angeles.*

DEMAND METER, GRAPHIC.

Tests have been made on the adaptability of the Lincoln demand meter of the graphic type for recording the maximum demand on highly fluctuating loads, such as a rubber mill, a street railway, etc. A standard paper feed of 0.5 in. (1.27 cm.) per hour was used, and also a special feed of 2 in. (5.1 cm.) per hour. In spite of the violent fluctuations of the load, each ten-minute peak could be read easily as the highest point on the traced curve.—*Hydro-Electric Power Commission, Toronto, Canada.*

ELECTROLYSIS, AMERICAN COMMITTEE ON.

The American Committee on Electrolysis, which is composed of representatives of the electric light, street railway, telephone and other interests, has established a research sub-committee to conduct local investigations. Prior to the organization of this research committee these investigations were conducted by the Bureau of Standards, and since the establishment of the committee the bureau has been co-operating with it.

ELECTROMOTIVE FORCE, NATURE OF.

Free electrons are considered in a metal, and a distinction is made between their volume density, or space charge, and the number of electrons which pass through a cross-section of the conductor and constitute an electric current. A relationship is deduced between the electromotive intensity and the mechanical force acting on electrons, to explain why the induced e.m.f. is independent of the material of the conductor. The resistance of the conductor is shown to be inversely proportional to the square of the quantity of electricity in the space charge per unit length of conductor.—*C. R. Underhill, New Haven, Conn.*

ELECTRONIC MOTION.

A great deal of work has been done on the motion of electrons between coaxial cylinders, in particular between a straight filament and a concentric cylindrical anode. Theory shows that the thermionic current in this case is unaffected by a uniform magnetic field parallel to the filament so long as this field is smaller than a critical value, but falls abruptly to zero when the field is increased beyond this value. The theory is completely confirmed by the experiments made, and applications are discussed in a paper delivered before the A. I. E. E. May 20, 1921.—*Albert W. Hull, Schenectady, N. Y.*

ELECTROPLATING, "BLACK NICKEL," SOLUTION FOR.

Black nickel, used for producing a dark finish on brass or other metals, has been produced by alkaline cyanide and neutral sulphocyanate solutions. The latter have been found to be the most satisfactory. The solution can be applied to brass either directly or after copper plating, to copper and to steel which has been coated with copper, nickel or zinc.—*Bureau of Standards, Washington, D. C.*

FATIGUE IN METALS.

Research in fatigue phenomena in metals is now in progress and has been further aided by recent contributions. One industrial electrical corporation has given a large sum so that the program may be extended to cover nickel steels of special interest to it.—*Engineering Experiment Station, University of Illinois, Urbana.*

HUMAN BODY, ELECTRICAL RESISTANCE OF.

Measurements have been made of the electric resistance of the human body for the first time in such a way as not to include the resistance through the skin where current entered and left the body. For this reason the results are more consistent than any previously obtained. These show that (a) the resistance of the same part of the body of different individuals may differ by a ratio of three to two or even more, (b) the resistance of a person changes from day to day and often by small amounts in an hour, (c) the resistance depends to some extent upon the position of the body and the extent to which the muscles are relaxed, (d) part of the difference found between different persons and some of the changes observed in the same persons depend upon pathologic conditions. Complete report of results will be available at a later date.—*Bureau of Standards, Washington, D. C.*

INDUCTANCE COILS, STANDARDIZATION OF.

A careful study of the constants and behavior of inductance coils has been begun with a view of the production of standards and also of their practical development and use in radio work. The results of this work have given formulas for the calculation of the capacities of short single-layer solenoids, pancake coils and multi-layer coils of circular or square section and large diameter. Special shielded coils of calculable capacity have been developed for use as standards. No printed information is yet available, as the work is still in progress.—*Bureau of Standards, Washington, D C.*

INDUCTION MOTORS ON UNBALANCED POLYPHASE CIRCUITS.

A method has been developed by which the characteristic of a polyphase induction motor with unbalanced applied voltages can be predicted with considerable accuracy. The work is complete for the two-phase motor and is now under way for three-phase motors.—*B. F. Bailey, University of Michigan, Ann Arbor.*

Suggestions for Research

CABLES, UNDERGROUND, LOCATION OF FAULTS IN.

A detailed report on the methods of locating faults in use by various operating companies will be found in the *N. E. L. A. Proceedings*, 1920, pp. 735-738. The great variety of these methods and the growing importance of underground cables indicate a need for further research as to the best method for each particular set of conditions. A few such methods, standardized in their details, will save the operating companies considerable money and help to maintain better service.—*Editorial Suggestion.*

CONDENSER, HIGH TENSION, LARGE CAPACITY.

Information has been requested regarding the simplest and least expensive means of building a condenser of ½ mfd. to mfd. capacity, 100,000 volts, for the purpose of extending an investigation on the spectrum of explosive discharge through fine wires.—*National Research Council, Washington, D. C.*

GENERATOR, THIRD-BRUSH.

A further investigation is desired of the characteristics of the third-brush generator used for automobile lighting. My previous investigation reported in my book on the "Principles of Direct-Current Machines" does not cover the general case of the third brush in any arbitrary position, and it assumes a straight-line magnetization curve which is certainly not correct. —*A. S. Langsdorf, St. Louis.*

INDUCTIVE INTERFERENCE, FIELD INSTRUMENTS FOR.

One of the most important steps to be taken at this time is to make available a set of comparatively rugged and fairly accurate field instruments with which the essential data on the communication circuits as well as on the power circuits while under regular operation may be obtained. Otherwise the information will continue to come in the form of qualitative, inaccurate data and personal opinion.—*H. L. Wills in the N. E. L. A. Bulletin.*

TRANSFORMERS, LOAD INDICATOR FOR.

One of the most perplexing problems regarding transformers in a distribution system is to know the load conditions under which they are working. It is desired that a load-indicating device be developed which shall be inexpensive and so designed that transformers now in service may be equipped with it. It should be maximum-reading and indicate whether the transformer has been overloaded. It should be made so as to admit resetting at any time and should preferably be visible from the ground.—*N. E. L. A. Overhead Systems Committee.*

WATT-HOUR METERS, INDUCTION TYPE.

The claim has been made that the usual induction watt-hour meter is inaccurate on heavy overloads. This matter has become of considerable practical importance since there are many small consumers with 5-amp meters who at times use 10-amp. domestic appliances, sometimes in addition to a lighting load. A simple attachment is desired which would not affect the speed of the meter up to a reasonable overload and would automatically correct the speed on heavy overloads. The name "curve-straightening device" has been suggested for such an attachment.

WELDING, ELECTRIC.

There is need for further research in electric welding practice. Tests indicate that there is a margin of about 25 per cent for improvements over the present average quality of weld. The factors to be investigated are as follows: (a) The proper current to use with the various sizes of electrodes for different thicknesses of plates; (b) the effect of the size of the angle of opening upon the strength of the weld; (c) the relative efficiencies of different types of joints; (d) the proper number of layers and the current to be used with various thicknesses of plate and positions of welding; (e) the kinds of electrodes to be used; (f) the proper method of welding long seams; (g) a simple non-destructive test of the strength of a welded joint.—*William Spraragen, New York City.*

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Senate Rider to Start Great Falls Project Killed in Conference

THE Senate amendment to the army appropriation bill authorizing the expenditure of $200,000 to start work on the Great Falls water-power project was eliminated from the bill in conference. The House conferees insisted that a project which ultimately was to cost $50,000,000 should not be authorized by means of a rider on the appropriation bill. A separate measure which will insure thorough consideration by Congress will be introduced at once.

Alabama Power Company Offers $2,500,000 in 6 per Cents

AN ISSUE of first mortgage refunding gold bonds totaling $2,500,000 has been placed on the market by the Alabama Power Company. These are thirty-year bonds in the 6 per cent series and are offered at 84¾ and interest, to yield 7¼ per cent. They are callable as a whole or in part on any interest date, on thirty days' notice, at 105 and interest, to and including June 1, 1932, and thereafter at a premium reducing one-quarter of 1 per cent per annum.

The company plans soon to begin construction of a second large hydro-electric development to be known as the Mitchell power plant, which will have an initial installed generating capacity of 60,000 hp. and an ultimate capacity of 120,000 hp. The addition of this new 60,000-hp. unit will increase the company's present hydro-electric capacity by over half and will increase its total installed generating capacity to 220,000 hp., of which more than 77 per cent will be hydro-electric.

The United States Chamber of Commerce Urges Governmental Reorganization

IMMEDIATE departmental reorganization of the federal government along more modern and efficient lines is urged by the Chamber of Commerce of the United States in a communication sent to members of the joint congressional committee on reorganization by Elliot H. Goodwin, resident vice-president of the chamber.

"At a time when the expenditures of our government exceed four billion dollars a year," the communication says, "it is self-evident that all possible economy in the operation of the machinery of government is a matter of vital concern to every citizen, and particularly to every taxpayer. The present system of departments and bureaus, with their network of subsidary offices and services extending over the entire country, has developed bit by bit through a great number of years. It has long been a matter of general belief that the system as a whole lacks co-ordination and general efficiency.

"It is evident that many public officials are underpaid. But it is highly probable that the saving which can be effected through the combination of similar services now separately and wastefully handled will save money ample to provide not only for needed salary increases but also for entirely new services which modern conditions urgently demand and still leave a handsome unexpended balance."

Canadian Electrical Association Faces the Business Situation Confidently

CANADIAN electrical utilities reflect in a measure the present depressed business conditions existing in the Dominion. At the thirty-first annual convention of the Canadian Electrical Association, held at the Chateau Frontenac, in the ancient city of Quebec, on Wednesday, Thursday and Friday of this week, there were indications that the electrical utilities are meeting the situation resolutely, and while the period of depression is expected to last a while longer, there is no alarm felt as to the outcome. Throughout Canada almost all of the electricity used is obtained from hydro-electric sources, hence the cost of the user is low and the use per capita high. Curtailments in manufactures have necessarily reduced the industrial demands on the electric light and power systems, but not to such an extent as to interfere with new construction work now going on in the Provinces of Quebec and Ontario. The loss of revenue up to the present has not been serious.

Being a geographic division of the National Electric Light Association, many of the papers read at the convention of the Canadian association reviewed the work of the national committees, and the reports made at the Chicago convention were interpreted and modified to meet Canadian conditions. On Thursday morning a series of papers requiring lantern slides was presented by representatives of manufacturing companies, and for that reason the morning session on that day was held in the Empire Theater. The principal committee reports presented dealt with meters, apparatus, overhead systems and rates. In addition papers were read as follows: "Electrical Standards and Their Application to Trade and Commerce," by O. Higman, director of the Electrical Standards Laboratory at Ottawa; "Electrons," by W. B. Cartmel of the Northern Electric Company; "Modern Street Lighting," by A. B. Cooper of the Canadian General Electric Company; "Switchboard Equipment," by L. B. Chubbuck of the Canadian Westinghouse Company; "Manufacture and Testing of High-Tension Porcelain Insulators," by A. D. Allen of the A. D. Allen Inspection Company; "The Consulting Engineer and the Power Company," by J. M. Robertson of Montreal.

The speakers at the Wednesday night dinner included President A. Monroe Grier, W. L. Goodwin of the Society for Electrical Development, Samuel Chase of the Westinghouse Electric & Manufacturing Company and W. H. Onken, Jr., editor of the ELECTRICAL WORLD.

Milo R. Bump, president-elect of the National Electric Light Association, was in attendance on Thursday and Friday and took part in the deliberations.

The committee on meters, in view of the excellent service given by the induction-type meter, suggested that the inspection-seal period of five to six years now provided for in the Dominion of Canada electricity inspection act be increased by three years. The committee on electrical apparatus voiced the desirability of some standard schedule for rating large oil circuit breakers as to rupturing capacity and performance. Mention was made of a recently developed sectionalized drive for paper-making machinery consisting of many individually driven units of different speeds the relation of which to each other does not change. All of the motors are driven from a direct-current adjustable-voltage generator with a separate constant-voltage exciter capable of furnishing excitation for the synchronous-motor fields, the motor fields and the various control circuits. The entire equipment is automatic and is installed in the plant of the Abitibi Pulp & Paper Company. The desirability of minimum guarantee clauses in power contracts to cover the full expense of maintaining service was recommended by the Commercial Section committee. In his report as chairman of the Public Relations Section D. M. McDougall cited the good-will campaign of the National Electric Light Association and suggested that the "Kilo Watt" pamphlets be rewritten, giving Canadian statistics and comparisons so as to make them applicable to the needs of the Dominion of Canada.

British Manufacturers' Association Holds to 40-Deg. Standard

COPIES have just been received in this country of specifications for industrial electric motors and generators published in May by the British Electrical and Allied Manufacturers' Association. These specifications, which represent present-day British practice with regard to industrial motors and generators up to 1,000 kw., still cling to the 40-deg temperature rating for class A, or fabric, insulation for all machines other than totally inclosed. The question of whether 40 deg. or 50 deg. is the better rating has been under discussion in England for some time, and while it is not felt in this country that there was unanimity of opinion among "Beama" members, still it is apparent that there was a majority opinion of sufficient strength to warrant the action of the association in specifying 40 deg. as the official rating.

City of Los Angeles Would Obtain Private Plant by Condemnation

THE CITY of Los Angeles has instituted a condemnation suit in the United States District Court to obtain possession of the Adams station of the Southern Sierras Power Company. The city contends that the needs of a municipality rank above those of private interest. To this the defendant answers that the needs of the cities of Redlands, Riverside, and towns in the Imperial Valley served by it are of equal importance since they depend partly on the output of this plant for their power supply. This station, rated at 3,750 kw., is in the Owens River gorge in Mono County, Cal., and is valued by the Southern Sierras Power Company at approximately $1,000,000, including 320 acres of land.

Bureau of Standards Electrical Work May Be Divided

NO SELECTION has been made for the important post in the Bureau of Standards made vacant recently by the death of Dr. E. B. Rosa. It is not improbable that the work in electrical physics and that in electrical engineering may be conducted in the future by separate chiefs. It is recognized that it will be very difficult to obtain a man of Dr. Rosa's capabilities for a salary of $4,800. The problem will be simplified, it is believed, by placing the two sections of the electrical division under separate directors. E. C. Crittenden is acting as chief of the electrical division.

Power Club Unanimously Opposes Chicago Ordinance

TARIFF, the 40-deg. or 50-deg. temperature question, the proposed consolidation of the three manufacturers' associations and the proposed Chicago electrical ordinance received the major portion of attention at the annual meeting of the Electric Power Club held June 6, 7, 8 and 9 at Hot Springs, Va. The members declared themselves as one in opposition to the proposed Chicago ordinance, which would license and regulate the sale and installation of electrical appliances and passed a resolution to that effect.

The regular routine of business, including the reports of the committees of the separate sections, was carried out, and the reports were adopted. On the evening of June 6 at the annual dinner John W. O'Leary, vice-president of the Chicago Trust Company, made a very interesting address on "Some Business Observations."

The report of the tariff committee was listened to with considerable interest. There is now one committee representing the entire electrical industry and known as the tariff council committee, of which S. L. Nicholson is chairman and A. W. Hanshaw secretary. It has a paid adviser, William Burgess, in Washington to keep the committee fully advised of political developments and so protect the interests of the industry. The committee is very much in favor of American valuations on imports rather than those declared at the port of shipment. The American electrical manufacturers are not endeavoring to build up a tariff wall, but rather to bring about a tariff that is just and reasonable to American labor.

The proposed consolidation of the electrical manufacturers' associations was fully discussed, but it is still in a formative state. A constitution and set of bylaws were presented by the committee for consideration, and to these certain modifications were suggested.

No definite action was taken on the question of 40-deg. versus 50-deg. temperature rise, although it was very fully discussed at a special meeting of the motor and generator section.

R. J. Russell, vice-president and secretary of the Century Electric Company, St. Louis, was chosen president of the Electric Power Club; C. H. Roth, president Roth Brothers & Company, Chicago, was made vice-president and re-elected secretary, and J. K. Bass, president Kimble Electric Company, Chicago, was chosen to be treasurer. Four governors were elected as follows: S. L. Nicholson, Westinghouse Electric & Manufacturing Company, and F. M. Kimball, General Electric Company, re-elected, and J. F. Lincoln, Lincoln Electric Company, and J. K. Bass.

New Federal Department Proposed to Take Over Power Work

A PROPOSAL that the Federal Power Commission be "abolished and all duties, powers, equipment and all that pertains to said commission be transferred to the Department of Mines and Mineral Resources and placed under its jurisdiction and made a part thereof" is contained in the bill drafted by Senator Shortridge of California.

In the new Federal Department of Mines and Mineral Resources which Senator Shortridge would set up he proposes to have a Bureau of Power Development. This bureau would be under the immediate direction of a chief engineer to be appointed by the President at a salary of $7,500. He suggests two consulting engineers for the bureau, at $5,000 a year each.

The Secretary of Mines under this bill would have authority to transfer to the Bureau of Power Development the work of the United States Geological Survey dealing with the gaging of streams and the investigation of water resources. In addition this bureau would be the custodian of the records of the Superpower Survey.

The new department as proposed by Senator Shortridge would absorb the work now being done by the United States Geological Survey, the Bureau of Mines, the War Minerals Relief Commission, the California Débris Commission, the Federal Power Commission and the Bureau of Explosives of the Interstate Commerce Commission, as well as such portions of the work of the Bureau of Standards, the General Land Office and the Indian Office as pertain to mineral lands or the regulation of mineral activities on the public or Indian lands.

Iowa Section, N. E. L. A., Will Discuss Farm Lines and Rates

MEETING at the Inn Hotel, Lake Okoboji, Iowa, next week, the Iowa Section of the National Electric Light Association will follow this program:

WEDNESDAY, JUNE 22

Morning—Reports and general discussions.

Afternoon—"Overcoming Excessive Loss in Farm Lines," by E. L. Fischer, general manager Muscatine Lighting Company; "Reports of Tests on Typical Farm Line Installations," by V. L. Hein, engineering extension department, Ames; paper on subject to be selected, by A. B. Campbell, electrical engineer Iowa Railroad Commission, Des Moines; "Liability Insurance Covering Electric Transmission Lines," by W. A. Woodward, Iowa Railway & Light Company, Cedar Rapids, and Mr. Block, Lynton T. Block & Company, St. Louis, Mo.; "The Law of Tree Trimming for Clearance of Electric Transmission Lines on Public Highways," by Rex H. Fowler, Des Moines; "Liability of Transmission Line Companies for Assessment Incident to Drainage Projects," by Rex H. Fowler, Des Moines; "Inductive Interference," by John M. Drabelle, electrical and mechanical engineer Iowa Railway & Light Company, Cedar Rapids.

THURSDAY, JUNE 23

Morning—"Modern Power-Station Economies," by E. S. Hight, chief operating engineer Illinois Traction System, with discussion by John M. Drabelle, C. A. Sears and C. G. Johnston; "Electrical Merchandising," by Ira Steele, commercial manager Des Moines Electric Company; paper on "Electric Cooking and Heating."

Afternoon—"Valuation and Rate of Return," by L. R. King, valuation engineer United Light & Railways Company, Davenport; "Rates," by Austin Burt of Waterloo, N. T. Wilcox of Keokuk, C. N. Chubb of Davenport, H. C. Orton of McGregor, M. G. Linn of Des Moines and J. B. Hill of Iowa City; "The Establishment of an Iowa Committee of Public Utility Information," by O. H. Simonds, general manager Dubuque Electric Company, and Horace M. Davis, director Nebraska Committee on Public Utility Information, Lincoln, Neb.; committee reports and election of officers.

Evening—Banquet, with address by speaker to be selected. Col. W. G. Dows, president Iowa Railway & Light Company, Cedar Rapids, will be toastmaster, and the convention dance will follow the banquet.

FRIDAY, JUNE 24

(Joint session with Iowa Electric Railway Association)

Morning—"The Sale of Public Utility Securities," by H. E. Weeks, treasurer United Light & Railways Company, Davenport, with discussion by S. Dows, E. F. Bulmahn and C. Miller; "A Discussion of the Law Pertaining to the Regulation of Electric and Gas Rates and Street Railway Fares in Iowa," by William Chamberlain, general counsel United Light & Railways Company, Cedar Rapids, and John A. Reed, general attorney Iowa Railway & Light Company, Cedar Rapids; report of legislative committee, by F. J. Hanlon, Mason City.

Afternoon—Separate session of the Iowa Electric Railway Association.

Pacific Coast Electrical Utility Men Hold Industrial Symposium

THE last afternoon and evening of the convention of the Pacific Coast Division, N. E. L. A., were devoted to a symposium of papers and addresses on the industrial standing and prospects of the Pacific Coast. To the prominent men of the industrial world who were specially invited to the convention it was emphasized that the further progress of the West as an industrial center was inseparably bound up with the development of hydro-electric power. In order to make this point as definite as possible an industrial survey had been made in that territory by the Western section of the N. E. L. A. and the *Journal of Electricity and Western Industry*. This survey presented by means of charts the growth of the West industrially in relation to hydro-electric development.

Phases of the survey were presented by Robert Sibley, editor of the *Journal of Electricity and Western Industry;* W. E. Creed, president Pacific Gas & Electric Company; H. G. Butler, Power Administrator of California, and A. E. Wishon, general manager San Joaquin Light & Power Company. Mr. Creed stated that the successful financing of the huge construction program facing the Western companies lay in the sale of junior securities. J. B. Miller, president of the Southern California Edison Company, who presided at this meeting, said that his company was not planning the development of the tremendous powers of the Colorado River alone, but that it was working on a plan whereby the other companies in the territory could receive the benefits of large blocks of power.

M. H. Aylesworth, executive manager of the N. E. L. A., addressed the general session on Friday on public relations, pointing out the necessity of telling the story of the electrical industry to the man in the street so that he may understand that his self-interest is inseparably bound up with the success of that industry.

A. B. West, vice-president of the Southern Sierras Power Company, was elected president of the Division, J. B. Black, commercial manager Great Western Power Company, first vice-president; L. M. Klauber, general superintendent San Diego Gas & Electric Company, second vice-president, and Henry Bostwick, Pacific Gas & Electric Company, treasurer.

Pennsylvania Power & Light Company Not Contemplating New Plants

REPORTS have been circulated that the Pennsylvania Power & Light Company has obtained power sites in the territory in which it operates and on which are to be erected large electric generating stations. The latest report is that the company has obtained a site on the Susquehanna River near the mouth of Roaring Creek, just below Catawissa, Pa. It was authoritatively stated to a representative of the ELECTRICAL WORLD that the reports of these projected central stations are entirely incorrect. The company is now actively engaged in increasing the facilities of its two present electric generating stations at Harwood and Hauto, and this is the only power station construction now contemplated by the company.

The generating capacity of the Hauto station is being increased from 30,000 kw. to 50,000 kw., and the generating capacity of the Harwood station is being increased from 33,000 kw. to 41,500 kw.

New Electrical Industrial Co-operative Course at Worcester

A NEW course, designed to provide for a closer connection between the curriculum and outside industry, has been announced by the Worcester (Mass.) Polytechnic Institute for its department of electrical engineering. Under the new plan each student registering in the department will have his choice of two courses—first, the regular four-year course as at present, and, second a course corresponding to the present course for the first three years, but with the provision that at the end of the third year the student will enter one of the electrical industries for a period of from twelve to fifteen months. At the conclusion of this period, he will return to the institute for his final year. The main object of the alternative course is to furnish training of a type which is ordinarily received only after graduation. The training will be carried on under direct institute influence, and each participant will be considered a non-resident student, keeping in close touch with the department. Among the companies interested in co-operating are the General Electric Company, Westinghouse Electric & Manufacturing Company, American Telephone & Telegraph Company, Worcester Electric Light Company and New England Power Company. Prof. Harold B. Smith is head of the department of electrical engineering at the Worcester Institute.

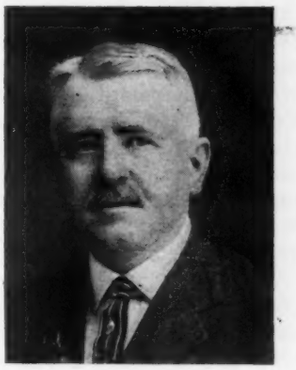
International Chamber of Commerce Meets on June 27 in London

MORE than two hundred leading American business men have sailed to participate in the first annual meeting of the international Chamber of Commerce in London during the week of June 27. With the restoration of the world's commerce as the main theme, this conference promises to be one of the most important international meetings of business men held in recent years. Eleven countries will send delegates—Belgium, France, Italy, Great Britain, the United States, Poland, Greece, Holland, Czechoslovakia, Denmark and Sweden.

The program has been divided into five general subjects, all having an important bearing on the main theme of the conference, and the convention will be organized into five groups, each group taking up one of these five general subjects. The subjects are transportation and communication, finance, production, distribution, and devastated regions.

D. L. Gaskill Sees Profitable Field in Rural Service Lines

TEN years from now rural service lines will cover just as much territory as do the telephone lines at the present time. This statement was made by D. L. Gaskill, president of the Greenville (Ohio) Electric Light & Power Company and secretary of the Ohio Electric Light Association, who was in New York recently and was asked by a representative of the ELECTRICAL WORLD to express his views on the rural-line situation. Mr. Gaskill's company serves upward of 400 rural customers.



D. L. GASKILL

"The principal load on our rural lines," said Mr. Gaskill, "comes from lighting and small appliances. It must be remembered that we are serving a territory where there are real farmers who live on forty, sixty or eighty acres of land and make their living from it. These farmers have very little use for large power and what requirements of 10 hp. to 15 hp. they have can be procured much cheaper than in an electrical way. Threshing grain takes but a day or two and ensilage cutting perhaps three days per year on each farm, while the necessary grinding of feed for a month can be done in half a day. It would not pay the farmer to install transformer capacity and motors large enough to do this work, especially as the present farm tractors are provided with a band wheel and will do the work much more cheaply.

"Lighting, small power for pumping water, operating cream separators and washing machines, flat irons and other appliances make up the load on the average farm. The demand is at almost all times less than 1 kw. In fact, among more than 400 rural customers served by us, I never knew of the demand exceeding this amount. The total use of energy is small, averaging 12.5 kw.-hr. per customer per month. Our rate for this service is a fixed charge of $1 per kilovolt-ampere of transformer capacity per month plus an energy charge of 10 cents per kilowatt-hour."

Asked what the fixed charge covered, Mr. Gaskill pointed out that while there are no interest charges on the lines, as these are built by the farmers, then turned over to the company and cannot be capitalized, there is a maintenance charge of 5 per cent. Transformer and copper losses average 15 kw.-hr. per customer per month, and the cost of reading meters is approximately 7 cents in the country against 2 cents in the city.

"These extra expenses of maintenance, reading meters and high transformer losses," said Mr. Gaskill, "must be covered by a fixed charge. The expense of

maintaining service—that is, answering trouble calls or making other miscellaneous repairs—is much lower than would be expected. The farmer has always been accustomed to doing his own repairing on farm implements and machinery and seldom calls on the company to replace blown fuses or make other minor repairs.

"On our rural lines the number of customers averages five to the mile, and the average gross revenue per customer is $24 per year. All of these lines have been built by the farmers at a cost of from $700 to $1,000 per mile, depending upon whether they were for 2,300 volts or 6,600 volts. The company specifies that not less than No. 6 bare copper wire be used, and all work must be of standard construction.

FARMERS BUILD LINES

"We do not push the construction of these lines, but when a group of farmers desires to construct a new line we hold a meeting, at which time we explain all the details and conditions. No attempt is made to compel the farmers to purchase material from the central-station company; in fact, we advocate their procuring bids and buying from the jobbers as much as possible. We have found that this policy puts the company in the right light and the farmers do not get the impression that they are being exploited. At this time we also fix in the farmers' minds why they must pay a higher rate for service than that paid by customers in town, and when the reasons for the fixed charge are explained the farmers readily understand and accept them.

"The expense of constructing a new line is shared equally by the farmers taking service. That is, if a line 2 miles long costing $1,500 is required to serve ten farms, each would pay one-tenth of that amount. As a rule all available customers are taken on when the line is built, but should another connect to the line within ten years he must pay in his prorated share, or one-eleventh of the cost, which is divided among the original ten. For extensions to the end of a line the new customers do not pay a part of the cost of the original line, but for side lines and taps we have a special form of agreement covering the varying conditions which arise.

"So far it has not cost any of the farmers more than $300 to obtain service, this including the building of the line and necessary wiring in the house, barn and outbuildings."

Wisconsin Utility Tax Rate Increased 11 per Cent

THE Wisconsin Tax Commission is authority for the statement that the rate of taxation on electric light, heat and power, electric railway and gas utilities for 1921 has been increased more than 11 per cent. The rate determined on for 1921 is 0.02106389, or $21.06 per $1,000. The rate for 1920 was 0.0185318. Assessments on these public utilities will be considered by the commission in July and August.

Taxes paid by the utilities mentioned amounted to $2,151,466.72 in 1920, an increase in ten years of 238 per cent. Values increased in the same length of time 101.4 per cent. Taxes paid by street-railway and electric light and power companies are paid into the state treasury. The state retains 15 per cent; 65 per cent goes to cities, towns and villages, and 20 per cent to the counties.

Navy Department Satisfied with Final Test of Tennessee

THE Navy Department is understood to be entirely satisfied with the final tests of the battleship *Tennessee*, according to information received by the ELECTRICAL WORLD from its Washington correspondent. The electric propelling machinery functioned perfectly and demonstrated the superior maneuvering power of the electric drive. The salvo test—the firing of all twelve of the 14-in. guns at once—caused no injury to the electrical equipment of the ship. The propelling machinery of the *Tennessee* consists of two 15,000-kva. Westinghouse turbo-generators and four 8,375-hp. Westinghouse motors.

I. E. S. Elects Officers for Next Year

ANNOUNCEMENT was made this week of the results of the balloting for officers of the Illuminating Engineering Society for the fiscal year commencing Oct. 1, 1921. The officers elected are:

President—Dr. George S. Crampton, Philadelphia.

Junior past-presidents—Samuel E. Doane, Cleveland; George H. Harries, Chicago.

Vice-presidents—F. M. Feiker, New York; James J. Kirk, Chicago; H. F. Wallace, Boston.

Secretary—Clarence L. Law, New York.

Treasurer—L. B. Marks, New York.

Directors—F. C. Caldwell, Columbus, Ohio; A. D. Curtis, Chicago; P. S. Millar, New York; Francis E. Cady, Cleveland; D. McFarlan Moore, Harrison, N. J.; Robert B. Ely, Bloomfield; Adolph Hertz, New York; Walton Forstall, Philadelphia; Frank S. Price, Boston.

Section chairmen for the fiscal year 1921-1922 will be: New York, H. V. Bozell; New England, William J. Drisko; Philadelphia, H. B. Andersen; Chicago, F. F. Fowle.

Dr. Crampton, the new president, is an ophthalmologist practicing in Philadelphia. He has previously served the society on committees and as an officer.

New England Public Utility Information Bureau Organized

TO DISTRIBUTE correct information about public utilities in the six New England states a public utility information bureau has been established under the direction of C. L. Edgar, president of the Edison Electric Illuminating Company of Boston; A. M. Barnes, president of the Cambridge Gas Light Company; E. W. Longley, vice-president of the New England Telephone & Telegraph Company; Arthur E. Childs, president of the Massachusetts Lighting Companies, Boston, and H. T. Sands, president of the Haverhill Electric Company. The bureau plans to maintain an office in Boston in charge of a salaried director and, besides issuing reading matter of interest to the public, expects to furnish commercial organizations with competent speakers.

Work Started on New Arkansas 33,000-Volt Line

WORK has started on the construction of a new 33,000-volt aluminum line for the Arkansas Light & Power Company from Stuttgart to Clarendon, where it will tie in with the Arkansas Utility Company, a distance of 20 miles. Work is expected to be completed by July 15. The Arkansas Utility Company will distribute to Clarendon, Brinkley and Cotton Plant.

Gas-Filled Lamps to Replace Series Arcs in New $40,000 Installation

THE Department of Public Service of Hamilton, Ohio, has announced the completion of plans to rebuild the street-lighting system of that city. The system as laid out will require 1,400 lamps, 1,100-c.p. lamps being used in the business district, 600-c.p. lamps on the main thoroughfares, 400-c.p. lamps in the thickly-settled residential districts and 250-c.p. lamps in all outlying districts and in the middle of blocks where the distance is too great for street intersection lighting. Gas-filled lamps will be used, displacing series-inclosed arc lamps. In announcing the change, the department stated that it had been decided on for reasons of efficiency, lower maintenance charges and better illumination.

The installation will require a new switchboard of eleven circuits and eleven series transformers. The system at present has eight circuits. The cost of the installation will be approximately $40,000 and most of the material has been contracted for. It is expected to have it in operation by Nov. 1.

Foreign Countries to Be Asked to Participate in Exposition

ANOTHER step has been taken by way of preparation for the international exposition to be held in Portland, Ore., in 1925. The Senate has passed a bill authorizing the President to invite foreign countries to participate in the exposition, which is intended to celebrate the completion of the transcontinental and Pacific highways and the centennial of the invention of the electromagnet, as well as to exemplify the development of hydro-electric energy.

Rulings of Federal Power Commission

A RULING to the effect that the leasing of a project by a licensee to another would not be a voluntary transfer within the meaning of the water-power act has been approved by the Federal Power Commission. It was held, however, that the commission would have to give its consent to the terms and conditions of the sub-lease since it clearly was the purpose of Congress to have the commission retain control over its operation. A licensee may not escape his responsibility by leasing the property to another and will be held to account by the commission for the earnings of the project.

Another ruling is that the temporary withdrawal of public lands included within proposed extensions of the Sequois, Yellowstone and Crater Lake National Parks in no way interferes with the authority of the commission to license any water-power development within the areas temporarily withdrawn.

The commission also holds it to be unnecessary to advertise a project upon the filing of an application for license if it has been advertised at the time the application for a preliminary permit was filed.

In connection with the applications of the United Mills Company, the Granite Falls Manufacturing Company and the Catawba Valley Light & Railway Company, involving lands in the Boone national forests of North Carolina, the commission holds that the provision of the law providing for filing notice in the local land office is inapplicable, as in the provision regulating the opening of power-reserve lands to disposition under the public land laws.

In connection with the application of the Citizens' Light, Power & Water Company of Ketchikan, Alaska, to purchase timber from lands embraced within a power reservation it has been ruled that timber on such lands may be sold under the authority of the Secretary of the Interior.

Research and Labor Outstanding Problems, Says Dr. Nichols

IN THE presence of a distinguished assemblage of scientists, educators, engineers and public officials, Dr. Ernest Fox Nichols was inaugurated seventh president of the Massachusetts Institute of Technology at Cambridge on Wednesday of last week, succeeding the late Dr. Richard C. Maclaurin. Although the exercises were of extreme simplicity, the occasion was marked by a profound appreciation of the importance of engineering education and scientific research in attacking the problems of modern civilization, including labor issues as well as material advancement.

The inaugural took place in the Walker Memorial building, fronting the Charles River Basin, and included an invocation by the Rev. George A. Gordon, D.D., pastor of the Old South Church, Boston, and addresses by Dr. Elihu Thomson, acting president of the institute; Gov. Channing H. Cox of Massachusetts, President A. Lawrence Lowell of Harvard University, Prof. H. P. Talbot, chairman of the institute faculty, and President Nichols. In inducting President Nichols into office, Dr. Thomson said in part:

ACADEMIC PROCESSION AT INAUGURATION OF PRESIDENT NICHOLS

Left to right—Governor Channing H. Cox of Massachusetts, Edwin S. Webster of Stone & Webster, President Nichols, Dr. Elihu Thomson, acting president M. I. T.; Chief Marshal Frank L. Locke.

"The service rendered by the Massachusetts Institute of Technology during its existence of some few years more than half a century in establishing upon a firm basis technical education and engineering training would not have been possible had it not been fortunate in having exceptional men at its head—men of great ability, high ideals and intense, almost passionate realization of the future of science and its applications. The building up of a great school from small beginnings amid many difficulties required their unselfish devotion to a difficult task and earnest support from faculty,

alumni, at first very few, and the friends of the school. Their tireless effort led to increasing public confidence and general recognition of the value and necessity of the kind of training for which the school has stood—technology, broadened and illuminated by scientific study, work founded on thorough scientific research and investigation as against rule-of-thumb or traditional methods merely—not a narrow specialization, but learning which looks forward as well as backward, that uses history as a means of inspiration for further advance and achievement."

Closer contact between educational institutions and industry was commended by Professor Talbot, who said: "Most problems relating to the improvement or development rather than to the control of industrial operations resolve themselves into abstract problems in physics, chemistry, mechanics or electricity. The smaller research organizations have neither time nor facilities for their solution; even the largest are confronted with questions which demand access to large libraries, or special equipment, or co-ordinated attack by several specialists, and on such problems the staff and facilities of a technical school can be brought to bear with peculiar effectiveness, and the findings will be regarded as authoritative and impartial."

Broad Education Essential

The temptation to introduce more detailed technical courses at the expense of other background-building studies was discountenanced by President Nichols, who spoke in part as follows:

"The two outstanding industrial problems today are: (1) The more intensive application of scientific knowledge and research to the processes and products of industry; (2) the cultivation of better understanding and more wholesome relations between labor and management. Both of these problems may rightly claim attention in any modern scheme of technical education.

"With depleted reserves applied science must soon face one of two alternatives. Either it must descend from its past and present rapid succession of revolutionary achievements to a more modest hand-to-mouth existence, reworking old accomplishments and consuming next year whatever pure science at its present working rate may discover, or else the hosts of pure-science research must be vastly strengthened and the volume of their yearly output many times increased.

"Under these circumstances technical schools owe to modern industry the more intensive cultivation of research, with increasing emphasis on pure science.

"No industrial question is of greater importance than human relations in industry, and none is more complex or baffling. Yet no pains can be spared, or are being spared, to find remedial measures. Many hopeful schemes for a better human organization of industry have been suggested and are under trial, some fortunately with encouraging promise.

"The dominant bearing of this discussion on technical education is this: Our technical schools are training the future brain workers and managers of industry. We may, therefore, well ask ourselves at this time if there is anything we can do beyond what we are now doing to train our students to understand more fundamentally and to meet more successfully the gravest of all their future responsibilities, the organization and management of men—a responsibility which they and we owe, not to industry alone, but to the whole economic, social and political stability of the nation."

New Orleans Alarmed Over Inability of Utility to Meet Demands

THE gas and electric equipment of New Orleans, La., is no longer adequate, according to Receiver J. D. O'Keefe of the New Orleans Railway & Light Company, who announced last week that he will not be able to meet the demands for new installations. The receiver accompanied his announcement with a table showing the growth of the electric department in the past seven years, from 1914 to 1920. This indicates an increase from 120 per cent in the number of meters and 250 per cent in the output. The present generating capacity of dependable units is shown to be 45,000 kw., while the connected load is in excess of 67,000 kw.

The growth of the gas department is shown in a similar table to be as great. The city authorities have now suddenly awakened to the dangers that threaten the industrial expansion of the city and the complete cessation of the building program, at present on the eve of development. The industrial bureau of the Association of Commerce is really alarmed over the outlook and a hurried meeting of that body has been called to consider the problem.

No Bituminous Coal Shortage Anticipated

A REPORT by George H. Cushing, managing director of the American Wholesale Coal Association, to the members of the association at their annual convention June 7 and 8 gives five conclusions relative to the near future of the bituminous coal market that are of interest to electric light and power men. They are:

First—A general and pronounced revival of business at home is out of the question until after the middle of July, 1922; it will be unprecedented if it comes prior to July, 1923.

Second—No dependable revival of the export business is possible until political conditions in Russia have been stabilized.

Third—Without a marked revival of domestic or foreign business, or both, the existing capacity of the railroads cannot be so seriously taxed as to create another coal shortage.

Fourth—Except between Jan. 15 and March 15, 1922—when industrial consumers will be buying coal for storage in anticipation of a strike of the bituminous miners on April 1, 1922—the bituminous mines will not during this coal year produce in excess of 50 per cent of their rated capacity or in excess of 75 per cent of their normal production.

Fifth—By the end of 1923 the home market will express a demand for bituminous coal considerably in excess of 600,000,000 tons per annum; the foreign market should want 40,000,000 tons, and it will be with difficulty that we shall meet home demands. Then will follow a protracted period—hardly less than five years—during which bituminous coal prices will be uniformly high.

Stanley Patent Amendment Reported

THE Senate committee on patents has reported favorably and recommends the prompt passage of the Stanley amendment which requires foreigners to whom American patents are granted to conduct manufacture on a reasonable scale within the continental limits of the United States. Manufacture must begin within two years.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest

Radio Connects United States with Indo-China.—Plans have been completed whereby commercial radio messages may be sent from San Francisco via Hawaii, Guam and the Philippines to Hanoi or Saigon, in French Indo-China.

University of Arkansas Has Metermen's Course.—A special metermen's course under the direction of the department of electrical engineering of the University of Arkansas, Fayetteville, Ark., will be held from June 20 to June 24, with alternate class and laboratory work.

Popularizing the Electric Range in Virginia.—The State Corporation Commission of Virginia has granted permission to the Virginia Railway & Power Company to cut its domestic rates for electrical energy at Petersburg squarely in half, or to 5 cents a kilowatt-hour, for cooking, heating, battery charging and ice-making purposes. The consumer must use a minimum of 30 kw.-hr. It is hoped that under this rate electrical cooking will gain great popular favor.

Manufacturers of Indianapolis Ask Lower Rates.—At a meeting of the Indianapolis manufacturers, power rate committee recently plans were made to appeal to the Public Service Commission, to lower electric power rates in Indianapolis. This committee is composed of representatives of Indianapolis manufacturers who use electric power provided by local companies. It will ask the co-operation of the manufacturers' committee of the Chamber of Commerce in the movement.

Electrical Development in Russia.—According to a young Russian engineer, C. L. Lipman, who spoke recently in London before the Institution of Electrical Engineers, initial efforts to further the much-advertised soviet scheme of nation-wide electrification have actually been made under government control, though the general destitution and the dearth of engineering materials have not permitted progress much beyond the excavating and layout stage. Work on the Kashir generating station to supply Moscow and its environs is being rushed day and night, according to Mr. Lipman. At present the city is being illuminated by the Bogorodsky transmission station helped out by a temporary district station, and some large industries are said to be receiving power. In the Petrograd district a new station has been begun, the speaker said, on the Viazen marshes, and a huge hydro-electric plant has been put under construction on the River Svir. In the Donetz basin thirty power houses, with a total rating of 190,000 kw., are in operation in three of the chief districts, while 3,000 motors, totaling 122,240 hp., have been repaired and put to use. Another large power house was said to be under construction in the Kizelovsk coal district in the Ural.

Copies of Scientific Articles to Be Made Available.—The Research Information Service of the National Research Council announces that it is prepared to assist investigators by locating scientific publications which are not generally or readily accessible. It will also, when desired, have manuscripts, printed matter or illustrations copied by photostat or typewriter. The cost of copying varies from 10 cents to 25 cents per page. Requests for assistance should be addressed National Research Council, Information Service, 1701 Massachusetts Avenue, Washington, D. C.

Electric Irrigation in California.—San Joaquin County, California, has 183,853 acres of land under irrigation, according to the latest census figures, of which amount 31,915 acres is irrigated by means of electric power furnished by the Western States Gas & Electric Company, Stockton division. Electrical energy is rapidly becoming the most popular means of irrigating lands because of its flexibility, reliability and economy. Scarcely a week passes, it is reported, without applications to the company for service of this kind, which dates back only ten years. Today it serves a total of 13,527 hp. of this class of business, nearly all of which is in San Joaquin County.

International Lighting Commission to Meet in Paris in July.—The International Commission of Lighting, which was founded in 1913 to continue and extend the work of the International Commission of Photometry, will hold its first session at Paris on July 4 to July 9 next. Five technical sessions of the commission will be held, at which there will be considered the proposed international standard of lighting advocated by the British national committee, with reports by the committees of the United States, France and Great Britain, and the photometric nomenclature and definitions proposed by the same committees. Reports will be presented to the commission on the following subjects, among others, by the committees of the countries respectively indicated: Heterochromatic photometry (France and United States); use of light filters in heterochromatic photometry (United States); properties of the normal eye (Italy); relative visibility function and the mechanical equivalent of light (United States); automobile headlamps (United States); lighting rules from the point of view of safety and of health (France); lighting legislation (United States). The president of the commission is Prof. T. Vautier of the Lyons faculty of Science.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Utah Section, A. I. E. E.—Officers of this section have been elected as follows: Chairman, Paul P. Ashworth, distribution engineer Utah Power & Light Company; secretary, C. R. Higson, assistant to general superintendent Utah Power & Light Company; junior past-chairman, J. F. Merrill, dean of School of Mines, University of Utah; executive committee, H. W. Clark, J. A. Kahn, Robert Miller and W. A. Moser.

Spokane Section, A. I. E. E.—B. M. Merrill, superintendent of light and power for the Washington Water Power Company, was elected chairman of this section at the annual meeting on May 20. The other officers elected were: Vice-chairman, L. J. Pospisil; secretary and treasurer, H. L. Melvin; members of the executive committee, J. W. Hungate, J. S. McNair and D. F. Henderson. Following the A. I. E. E. election and annual dinner a meeting of the Associated Engineers of Spokane was held, at which Carl F. Uhden, chief engineer of the huge Skagit River project of Seattle, told of his work.

Denver Section, A. I. E. E.—At the annual meeting of this section, held Saturday, May 21, officers for the coming year were elected as follows: Chairman, Burton C. J. Wheatlake, manager supply department of the General Electric Company; vice-chairman, Edward A. Phinney, vice-president and general manager Jefferson County Power & Light Company; secretary-treasurer, Robert B. Bonney, educational director Mountain States Telephone & Telegraph Company. Prof. L. D. Crain, of the Colorado Agricultural College, Fort Collins, spoke on "Electricity on the Farm."

Coming Meetings of Electrical and Other Technical Societies

American Society for Testing Materials—Asbury Park, N. J., June 20-24.

A. I. E. E. Annual Convention—Salt Lake City, June 20-25. (For program see issue of April 30, page 1009.)

N. E. L. A., North Central Division—Duluth, Minn., June 21-23. (For program see issue of June 4, page 1332.)

National District Heating Association—Cedar Point, Ohio, June 22-24. (For program see issue of May 7, page 1069.)

N. E. L. A., Iowa Section—Lake Okoboji, June 22-24.

Association of Municipal Electrical Utilities of Ontario—Niagara Falls, Ontario, June 23-25.

Associated Manufacturers of Electrical Supplies—New London, Conn., June 27-30.

Society for the Promotion of Engineering Education—New Haven, Conn., June 28-July 1.

Ohio Electric Light Association—Cedar Point, Ohio, July 12-15.

National Association of Electrical Contractors and Dealers—Buffalo, July 18-22. (For program see issue of April 30, page 1010.)

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Transmission Tower on Right-of-Way Not an "Attractive Nuisance."—A boy who climbed an electric transmission tower erected on a right-of-way through land owned by the boy's father and, though he did not touch the wires, received a shock while in the "danger zone" that caused him to fall and sustain fatal injuries was a trespasser, the Court of Civil Appeals of Texas found, in McCoy vs. Texas Power & Light Company, and damages for his death could not be recovered. Notwithstanding that the tower bore no warning sign it did not constitute a nuisance attractive to children, in the legal meaning of the term. (279 S. W. 623.)*

Ownership of Supporting Structure by Another Does Not Abolish Duty of Protecting Wires.—Affirming a judgment for damages because of injuries sustained by a boy who climbed on a railroad bridge and came into contact with electric wires (New York, New Haven & Hartford Railway Company vs. Fruchter), the United States Circuit Court of Appeals asserted that a lawful structure may because of its attractiveness to children render its owner liable for harm resulting to a child lured by it. (See issue of June 11, page 1392). The company, it further held, was not relieved from its duty to guard the wire by the fact that it did not own the bridge, even though it was the bridge and not the wire which was the real attraction. (271 Fed. 419.)

What Constitutes a Navigable Stream?—In Economy Light & Power Company vs. United States the question of navigability came up for examination by the Supreme Court of the United States (see ELECTRICAL WORLD for April 30, page 1010.) The test of navigability, the court stated, "is whether the river in its natural state is used or capable of being used as a highway for commerce over which trade and travel is or may be conducted in the customary modes of trade and travel on water. Navigability, in the sense of the law, is not destroyed because the watercourse is interrupted by occasional natural obstructions or portages; nor need the navigation be open at all seasons of the year or at all stages of the water." A decision of a state supreme court that a river was not navigable is not conclusive on a federal court having different evidence before it. It is for Congress and not the courts to declare whether a navigable river which has fallen into disuse as a highway of commerce is to be abandoned as such a highway. (41 S. C. R. 409.)

Responsibility of Power Company for Low Wires Across Street.—The Alabama Power Company appealed from a verdict in a suit brought against it by one Fergusen, who was injured while driving on a street across which the company's wires were strung by the toppling over of crates with which his wagon was loaded because of these crates coming in contact with the wires. The company's plea that it was the duty of the plaintiff to look out for the wires was held by the Supreme Court of Alabama to be deficient in that it omitted any averment of fact which imposed on him such a duty, and the question asked a witness, "Whose duty was it at the time to maintain those wires?" though improper as calling for a mere opinion, was harmless to defendant, whose ownership and use of the wires had been clearly shown. (87 So. 796.)

Finding on Reasonable Inference of Compensable Injury Final.—The Supreme Court of Michigan has affirmed the award by the Industrial Accident Board of the state of damages for the death of a boilermaker found with life extinct under the boiler where he had been working (Paton vs. Port Huron Engine & Thresher Company). Although the testimony showed that the man had received an electric shock from a wet 110-volt lighting cord, the company maintained that the inference that this had caused his death was only conjectural and asked reversal of judgment under the legal rule that where two inferences equally consistent with the facts arise from the evidence one of which makes the employer liable and the other of which does not the application shall fail. This rule, the court held, does not apply where there exists a reasonable inference that the injury arose out of the employment. (182 N. W. 639.)

Los Angeles-Southern California Edison Contract Sustained.—In Miller vs. City of Los Angeles, a taxpayers' action to enjoin the city from carrying out a contract made two years ago with the Southern California Edison Company as the result of the indorsement by the voters of a bond issue to enable the municipality to purchase the company's distribution system within the city limits (see ELECTRICAL WORLD, May 31, 1919, page 1181), the Supreme Court of California has affirmed the judgment for the city rendered in the inferior court, holding (1) that under its charter empowering the city to purchase property necessary to furnish light, heat and power the city could purchase electrical energy for distribution; (2) that the city was authorized to contract for the sale of surplus electricity to corporations for distribution outside city, and (3) that a contract to purchase a distributing system without assuming indebtedness need not be submitted to the voters. (197 Pac. 347.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Compulsory Service.—The Wisconsin Railroad Commission has refused to allow a rolling-mill company operating an electric service for forty-four consumers to discontinue such service, although the owners asserted its unprofitable nature and their desire to withdraw from the business. The consumers protested against its abandonment and declared their willingness to pay fair rates.

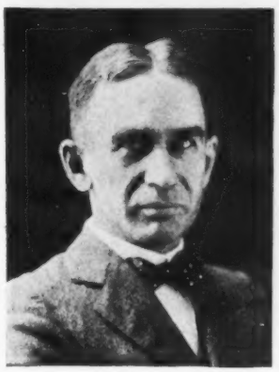
Responsibility for Tampering with Meter.—While utilities have an undoubted right to cut off service to patrons who misuse or abuse it, the Pennsylvania Public Service Commission has declared, the charge of tampering with a meter is too serious to be sustained except upon clear and satisfactory proofs. In a case where such proofs were not sufficient to convince the commission gas service was ordered restored. The Utah Public Utilities Commission ordered a consumer whose electric meter had been tampered with, but not, according to the consumer, with his knowledge or approval, to install protective devices on penalty of discontinuance of service.

Rates Increased in Indiana. — Increased rates for the Indiana & Michigan Electric Company, affecting virtually all its Indiana consumers in the St. Joseph River valley, except the larger industrial consumers, have been authorized by the Indiana Public Service Commission. The advances granted, however, were not so much as requested by the company. The commission estimated that its order would add $142,000 annually to the company's revenues, thus giving it a return of 8 per cent on an investment of $10,000,000. Domestic lighting rates in South Bend, Mishawaka, Elkhart and Ligonier were increased approximately 7 per cent, and commercial rates were advanced 10 per cent. Power rates for all consumers having less than 500-hp. demand also were advanced approximately 10 per cent. No increase was made in the domestic and commercial rates affecting other cities, except that the minimum monthly charge was fixed at $1.25 in the towns, not including the four larger cities, and at $2 in rural districts. The minimum monthly bill for the domestic consumers in the four cities was raised from 85 cents to $1. Half of the $142,000 increase in revenue estimated to result from the advances is expected to be borne by the smaller consumers, including householders, and the other half by the smaller power consumers.

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

E. J. Fowler, who was elected chairman of the Accounting Section of the National Electric Light Association at the convention in Chicago, has been statistician for the Commonwealth Edison Company and one of its predecessors in Chicago, the Chicago Edison Company, for twenty-three



E. J. FOWLER

years and has been with the company altogether twenty-five years. He was one of the pioneer substation operators in Chicago, his first position being that of operator of the old Adams Street distribution board. This position he held for a year and a half, being then transferred to the general office and assigned to statistical work, which has since developed into the present statistical department. In addition to this work Mr. Fowler developed the machine-billing and bookkeeping methods which are now in general use on the 500,000 accounts of the company. The only break in his service with the company occurred during the war, when he was commissioned a major in the Quartermaster's Corps, reporting for duty in April, 1918. He rendered valuable service at Washington in organizing and managing a statistical department in the Quartermaster General's office. Later, when the Quartermaster's Corps was reorganized, his work was classified as the statistical division of the office of the Director of Purchase and Storage. The most important part of this government work consisted of a monthly stock report showing goods at depots and in transit here and overseas. Such records had been very incomplete, but by means of his report Mr. Fowler largely prevented ordering on too great a scale, made it possible to give prompt attention to supplies which were running low and kept track of the location of available supplies, thus saving the government large sums. Mr. Fowler has been very active in the affairs of the Accounting National Section of the N. E. L. A. He organized and was chairman of the committee on customers' records and billing methods, and he was also chairman of the first committee on insurance. He organized and is now chairman of the committee on security holders' records. He is a member of the Western Society of Engineers. Mr. Fowler's education in electrical education was obtained at the University of Nebraska, Lincoln, Neb.

W. H. Harrington, formerly assistant chief engineer of the New Departure Manufacturing Company, Bristol, Conn., has been appointed electrical engineer of the Arrow Electric Company, Hartford, Conn.

Hartley Rowe, formerly manager of the Detroit office of Lockwood, Greene & Company, engineers, has been transferred to Boston as district manager, succeeding Kenneth Moller, who was recently made a member of the firm.

Ernest F. Learned has been appointed sales agent for the C. W. Hunt Engineering Corporation, with offices at 141 Milk Street, Boston. He will represent this organization in the marketing of coal and ash-handling machinery, industrial railways, industrial electric locomotives and other equipment for the conveying of bulk material as manufactured by the C. W. Hunt Company, Inc., of West New Brighton, N. Y.

J. R. Haskin has been appointed district manager of the Southern California Edison Company at Lancaster, to succeed H. A. Brody, who has been transferred to the new Lindsay district. Upon leaving college Mr. Haskin took up electrical work in the shops of the General Electric Company and Westinghouse Electric & Manufacturing Company, later going with the Niagara Falls Power Company. He resigned his position as assistant superintendent of the latter company during the Spanish-American War and saw active service in Porto Rico. On his discharge from the army he re-entered the Westinghouse organization and filled various positions in the engineering department until 1917, when he moved to Los Angeles and became power sales agent for the Los Angeles City Bureau of Power and Light. Early in 1920 he entered the commercial department of the Southern California Edison Company and received his appointment as district manager the first of this year.

Edgar Blessing of Danville, Ind., an attorney, has been appointed by Gov. Warren T. McCray as a member of the Indiana Public Service Commission to succeed E. I. Lewis, who resigned to become a member of the Interstate Commerce Commission. Mr. Blessing assumed his duties June 1.

E. J. Condon, Jr., has recently been elected assistant general manager of the Intermountain Railway, Light & Power Company, with headquarters in Colorado Springs, Col. Mr. Condon will be the active executive in charge of the operation and management of the eight central-station properties of the Intermountain company. He is also vice-president of the Condon Engineering Company of Chicago. During his

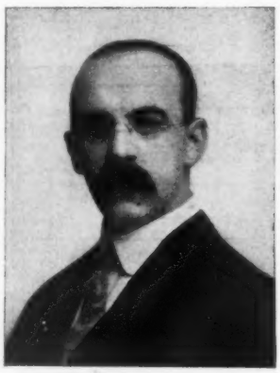
E. J. CONDON, JR.

past association with the operation of central stations Mr. Condon has been able to effect remarkable economies. He is a graduate of Armour Institute and gained wide electrical experience during war service in France. He has been superintendent of construction for the Indiana Utilities Company and manager of the Minnesota Electric Light & Power Company. He is an associate of the American Institute of Electrical Engineers and has served on the Indiana standardization committee.

Robert McF. Doble has been appointed on the engineering staff of the Metals Exploration Company as consulting engineer in charge of electric and hydro-electric power installations and operations. His headquarters will be at 201 Fourteenth Street, Denver, Col.

Major Harry B. Joyce, formerly of the Construction Division of the army, has resigned as a member of the firm of Johnson & Benham, Inc., consulting engineers, to assume charge of the engineering work of the Centrifugal Fan Company, Newark, N. J., engaged in the manufacture and installation of fans, blowers and ventilating systems. Major Joyce has had a broad experience in general engineering acquired in his consulting practice and as power engineer of the United Electric Light & Power Company, New York City.

W. E. Robertson, who at the Hot Springs meeting of the Electrical Supply Jobbers' Association last month was appointed a member of the executive committee of the National Electric Light Association, representing the electrical jobbers, is president of the Robertson-Cataract Company, Buffalo, N. Y. Mr. Robertson has been intimately associated with electrical work since 1898, when with his brother, James D. Robertson, he formed the Robertson Electric Construction Company. He has always been active in association work. He was one of the founders of the Society for Electrical Development and served as vice-president and director from its organization until Jan. 1, 1920. Mr. Robertson has also been one of the leaders in the Electrical Supply Jobbers' Association, having served for a number of years as a member of the executive committee and during the war as chairman of the war service committee. In 1917 he served as chairman of the Atlantic Division.



W. E. ROBERTSON

Edward Rahm, Jr., formerly Pittsburgh manager of the Underfeed Stoker Company, Detroit, Mich., has established an office in Pittsburgh, under the name of the Industrial Equipment Company, to handle power-plant equipment.

J. B. Crane, who has recently joined the sales and engineering staff of the George T. Ladd Company, manufacturer of the Ladd water-tube boiler, has had more than fifteen years' experience in the construction and operation of power houses and enjoys a wide acquaintance among public utilities, engineers and mining men in various parts of the country. Mr. Crane is a graduate of Trinity College of the class of 1902. After several years in the testing department of the General Electric Company at Schenectady, N. Y., he became associated with the Great Northern Power Company at Duluth, Minn., as commercial manager and superintendent of operation. In 1915 he joined the Electric Bond & Share Company of New York City and conducted a power survey for the Appalachain Power Company in West Virginia. Later he went to South America, where he made a complete investigation and report of the general power situation in Brazil, Argentina, Paraguay, Uruguay and Chile. In the last two years he has been engaged in efficiency studies and service for the W. S. Barstow Management Association and J. G. White Management Corporation of New York.

Richard Gregory, comptroller of the Western Electric Company, New York City, has been made a member of its board of directors.

S. Wallace Murkland, who has been assistant comptroller of the Western Electric Company since 1918, is now general contract sales manager.

M. W. Brown has been made manager of the Dallas office of the Power Specialty Company, New York City, manufacturer of Foster superheaters, economizers and oil stills, with offices in the Linz Building.

William F. Meyer has been placed in charge of the new Kansas City office of the Power Specialty Company, New York City, manufacturer of Foster superheaters, economizers and oil stills. This office will be in the Reliance Building.

E. E. Baker, for many years secretary of the Mount Whitney Power & Electric Company, Visalia, Cal., a subsidiary of the Southern California Edison Company, has been appointed traveling auditor for the San Joaquin Valley districts of the latter company.

Isaac Hardeman has been appointed sales agent for the American Engineering Company, Philadelphia. Mr. Hardeman will represent the Taylor stoker in the States of North Carolina, South Carolina and Georgia. His office is at 816 Realty Building, Charlotte, N. C.

T. M. Hardin has been placed in charge of the new branch office in New York City of the Ross Heater & Manufacturing Company, Buffalo, manufacturer of boiler-feed water heaters, surface condensers, evaporators, etc. The new office will be at 2 Rector Street.

H. M. Davidson, who from 1903 to 1919 was connected with the Hayward Company, manufacturer of buckets, cranes, derricks, etc., has again become associated with that company. Among other duties he will have the general management of sales. For the past two years Mr. Davidson has been with the Ohio Locomotive Crane Company as general sales manager.

Carl E. Johnson, who was made vice-president and secretary of the U. S. Electrical Manufacturing Company of Los Angeles at the time of its recent reorganization, has been in the electrical manufacturing business almost all of his life. Upon graduation from public school he entered the employ of a small manufacturing company which produced direct-current generators. This was in the days when metal brushes were used on direct-current machinery. Later he was employed by the Western Electric Company and the Cutler-Hammer Manufacturing Company in various capacities. Mr. Johnson was born in Chicago, but early removed to San Francisco and entered the employ of the Union Iron Works in the winding department, where he remained two years. In 1906 he organized the Dynamo Electric Company of Los Angeles and engaged in the manufacture of electric motors. In 1908 the U. S. Electrical Manufacturing Company was organized and took over the Dynamo Electric Machine Company. Mr. Johnson served in the capacity of general manager of the former company until the latter part of 1920, when H. G. Steele, formerly of the Pittsburgh Transformer Company, became associated with the U. S. Electrical Manufacturing Company, Mr. Johnson then becoming vice-president and secretary. He has taken a leading part in the affairs of the local technical societies, where his counsel has always proved of great usefulness.

C. E. JOHNSON

Obituary

W. F. O'Neill, treasurer and general manager of the Penn Electrical & Manufacturing Company, Irwin, Pa., died May 27.

William Chappell, president of the Rainier Heat & Power Company of Seattle, recently died in Baltimore, where he had gone for special treatment. Mr. Chappell located in Seattle in 1899, following successful operations in the Klondike district.

James Prentice Snedden, Bayonne, N. J., general superintendent in charge of manufacturing activities of the Babcock & Wilcox companies, died June 11 at Johns Hopkins Hospital. Mr. Snedden was born in Wishaw, Scotland, July 7, 1863, and came to the United States at the age of thirteen. In 1899 he became associated with the Stirling Boiler Company and remained with the organization when this company was amalgamated with the Babcock & Wilcox Company.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Heating Device Schedule to Be Lowered July 15

ANNOUNCEMENTS are being received this week by licensees under the Marsh patent stating that with the exception of ranges all electric heating devices will be placed on a lower schedule effective July 15. Electric irons under the new schodule will receive a cut of one dollar. The new listing will bring the standard 6-lb. irons to $6.75. All the other appliances will be placed on approximately a 10 per cent lower list. Electric ranges generally, except on the cheaper type of construction, remains unchanged owing, it is said, to the heavy overhead and the limited market of today.

As to schedule discounts, whereas the previous maximum discount to jobbers was 42-3-2, the new discounts will be 40 and 10; maximum dealer discounts, heretofore 30 and 7½, are changed to 30 and 10; maximum holding-company discounts, heretofore 42 off, are to be changed to 40 off.

Some Actions Jobbers Took at May Convention

WHILE the Electrical Supply Jobbers' Association was in convention at Hot Springs, Va., in the latter part of May, two reports were adopted which were outlined in these columns on May 28—the report of the committee on methods and forms employed in the purchasing, receiving, shipping and charging departments of an electrical supply jobbing house was adopted, and the association unanimously adopted a recommendation that manufacturers issue price information on sheets of a standard size, color and printing arrangement.

The size indorsed for this sheet was 8½ in. x 10 in., and the color scheme approved was goldenrod for cost to the distributer, russet for cost to jobber, light blue for cost to contractor-dealer and pink for cost to consumer. This list supersedes that reported in the May 28 issue of ELECTRICAL WORLD, wherein the colors for distributor and jobber were reversed. Where manufacturers do not differentiate between jobbers and distributers, the goldenrod sheet was recommended, and where manufacturers do not issue contractor-dealer discounts on consumers' prices the blue sheets or the pink sheets respectively will not be required.

Because many different styles of binders are coming into use it was unanimously voted that the association recommended to manufacturers that their price information sheets be issued unpunched. Furthermore, it was recommended that sheets as issued should have a binding margin of at least 1½ in., preferably 1¾ in., and that the margin on the other three edges of the sheet should be ¾ in.

Action was taken also on two other important matters. In regard to the establishment of net prices and the elimination of the list and discount method of quoting and selling the national representative states that on a standing vote being taken at the convention every member in attendance, except two who were partly engaged in the hardware business, voted in favor of requesting the manufacturers when quoting and selling to adopt net prices instead of list and discount.

The other question affecting manufacturers was that of prepayment of freight where freight is allowed by the manufacturers. This received further consideration, and the jobbers, it is stated, showed themselves unanimously in favor of having manufacturers adopt this policy.

Two Minor Changes in Recent Lamp Schedule Listings

TWO changes in lamp listings effected May 1 were concerned with diffusing-bulb lamps and candelabra decorative lamps. As to the former, in the new standard price schedules the diffusing-bulb, vacuum type, tungsten-filament lamps are collected and listed separately in order to make for convenience in ordering. The 15, 25 and 40-watt large lamps with diffusing bulbs are now found under that schedule listing and it is hoped that this may assist in drawing attention to these sizes when frosted lamps are desired and in the end work toward a standardization in these sizes, full-frosted, and the elimination of odd sizes and frostings.

Candelabra decorative lamps have been transferred to the large-lamp schedules from the miniature schedules, subject to the same conditions of sale and purchase as the other lamps on these large-lamp schedules. The slender and roundbulb types of candelabra frosted lamps are also listed in the diffusing-bulb schedules.

Recent French and Spanish Import Tariffs Higher

NEW Spanish import duties put into effect May 21, it is understood on advices from Madrid, are from three to four times what the old minimum rates were on electrical materials and manufactures and are given below in pesetas:

Article:	New Rate	Old Minimum Rate
	Per Kilo	
Telephone and telegraph apparatus	7.50	2.50
	per 100 Kilos	
Rails	18.06	4.20
Pig iron	8.12	1.40
Railway wheels	52.00	13.00
Wire of copper and copper alloys	85.50	28.50
Electric cable and wire, insulated, over 1 cm. diameter	180.00	45.00
Same, less than 1 cm. diameter	300.00	100.00
Dynamos, etc., up to 100 kilos	300.00	75.00
Dynamos, etc., from 101 to 400 kilos	284.00	71.00
Dynamos, etc., over 400 kilos	150.00	37.50
Switchboards, etc	300.00	75.00
Pumps	120.00	30.00
Cranes	80.00	20.00

At the same time comes a review of some of the more important articles to which the import tariff applies which has been lately imposed by France. These items are given below in francs:

	In 1914	April 1, 1921	May 1, 1921
Rails	9 to 15	9 to 15	24 to 40
Porcelain	12.50 to 30	12.50 to 30 × 1.5 to 2.2	40 to 400 × 1.5 to 2.2
Incandescent lamps	525 to 1,050	525 to 1,050 × 1.7 to 3	1,400 to 1,800 × 1.7 to 3
Dynamo-electric machines	30 to 150	30 to 150 × 2.9	80 to 420 × 2.9
Electrical apparatus	45 to 150	45 to 150 × 3	100 to 420 × 2
Electric wire and cable	60 to 150	60 to 150 × 3	160 to 400 × 3
Armatures for dynamo-electric machines	50 to 150	50 to 150 × 3	110 to 300 × 3
Arc lamps	150	150 × 2	320 × 2
Iron and steel tubes	13.50 to 6,000	13.50 to 6,000	36 to 16,000 × 3
Storage batteries	25	25 × 3	66 × 3

Schedule Material Prices Marked Lower Last Week

FROM about the ninth to the thirteenth of June the various manufacturers of schedule materials increased some of their discounts and lowered certain list prices so that the general result was a decrease in prices averaging around 10 per cent in standard-package quantities. With this general easier price, however, it can hardly be expected that any great amount of business will be stimulated, for the building construction outlet is not yet in a condition to absorb any large amount of schedule material and wiring devices.

It has been an incentive for jobbers in many cases to order various amounts, but just enough to bring their much-depleted stocks up to a present-demand working basis. These stocks had been allowed to dwindle to low levels because jobbers had been expecting lower prices for some months. In many cases, on the other hand, jobbers will not be in a position to add much stock at this time because they already have a fair working supply.

Although it is rather difficult to list all the drops on the different schedules put out by the various manufacturers, the general line of socket material, switches, receptacles, plates and all accessories except wall cases are about 8 per cent lower in standard packages; shade holders are 10.5 per cent lower; fuse plugs came down about 34 per cent and plug cut-outs about 14 per cent.

At the same time pull-chain sockets are 10 cents lower, listing at 50 cents, standard ¼, in standard packages; 9 cents has been taken off flush receptacles, bringing the list to 21 cents, and 12 cents off hinged plates, bringing list to 28 cents. Many other changes have brought new lists down in varying amounts up to 15 cents.

Insulation Manufacturers Optimistic Despite Light Buying

QUIETNESS is still the prevailing feature of the electrical insulation market. Repair shops are buying hand to mouth for most of them are not busy. Industrials are operating at reduced capacity, and furthermore they ordered ahead when deliveries were long, so that little buying is being done in that quarter. Electric railways are endeavoring to get along on such insulating material as they have and buy only for immediate needs, and as the appliance industry has been slack for a long time, small motor manufacturers are not active. One of the latter, for instance, recently bought 15 lb. of mica where a normal order formerly totaled 100 lb.

The general outlook in this field is held to be far from discouraging, however. The very fact that motor manufacturers, electric railways, etc., are not stocking insulation means all the more potential business yet to be placed, and as it seems there is not a great volume of repair work being done insulation needs along that line are piling up. Just when this business will break is, of course, a question, but the majority of producers are not expecting anything much to develop before the first of September.

Buyers apparently do not yet have confidence in present prices despite the radical reductions which the latter have undergone. Prices are still declining, it is true, but it is possible this is largely a result of conditions of keen competition. Since the first of this year, according to one of the large producers; cotton tapes, webbings and sleevings have declined 70 per cent, 25 per cent of this drop occuring just this week; varnished cloths have declined about 28 to 35 per cent, one-fourth of which decrease also was made this week; cotton armature twines, except linen, are down 33⅓ per cent and insulating varnish about 20 per cent. India mica up to the present is undiminished in cost as the price at the mines has not been reduced, but the South American product is now somewhat lower.

Conditions of stock vary considerably, though all producers are pursuing a policy of keeping down inventories and only producing on order. Deliveries of standard material for the most part are immediate, as in general stocks are too large rather than too small under present buying.

Electrical Manufactures for 1919 Shown in Census Report

THE value of the products of manufacture of electrical machinery, apparatus and supplies for the year 1919 was $884,343,000, according to the annual report of the Director of the Census for 1920, just made available. In the Jan. 17, 1920, issue of the ELECTRICAL WORLD, page 160, it was estimated that sales of electrical manufactures during 1919 would run between $800,000,000 and $1,000,000,000. This estimate was based on the reports received from manufacturers of the various lines of electrical apparatus and supplies as the year 1919 was coming to a close.

The census report shows the growth of this business from the year 1914 through 1919, giving the value of these manufactures in 1914 as $335,170,000. The number of electrical manufacturing establishments in 1919 was 1,403, while in 1914 it was 1,030. The estimate of the ELECTRICAL WORLD of the manufactured value of electrical apparatus and supplies for the year 1920 has been placed at a figure just in excess of $1,250,000,000.

Continuing, the census report gives the values of other equipment of interest to the electrical industry as follows, the first figure being for 1919 and the second figure for 1914: Leather belting, $40,939,000 and $23,036,000; gas and electric fixtures, $42,269,000 and $28,740,000; steam and other power pumps, $53,716,000; and $17,864,000; copper smelting and refining, $632,897,000 and $444,022,000. The number of leather-belting establishments was 172 in 1919 and 151 in 1914; gas and electric fixture manufacturing establishments numbered 342 in 1919 and 460 in 1914; steam and other power pump establishments numbered 112 in 1919 and 87 in 1914; copper smelting and refining establishments numbered 33 in 1919 and 37 in 1914.

The Metal Market Situation

THE copper market is in about the same position as reported last week. The low foreign-exchange level continues to be an important factor in the situation, for with sterling quoted at about $3.73, foreign buyers can purchase copper at London cheaper than they can have it shipped from New York. Domestic consumers are indifferent and there is little buying. Producers are not pressing to sell, but at the same time they are not holding to the top prices that have been quoted. There are few if any offerings of prompt and June shipment by producers under 13¾ cents, while July is quoted at 13¼ cents delivered. In the outside market offerings are both a little freer and slightly easier.

Demand for lead is flat and the "official" price has been reduced to 4.50 cents per pound, New York. This reduction is probably influenced by the decline in pounds sterling. Zinc has gone a fraction under 5 cents per pound, but even at this attractive price there is very little buying.

NEW YORK METAL MARKET PRICE

	June 7, 1921	June 14, 1921
Copper	£ s d	£ s d
London, standard spot	72 15 0	73 7 6
	Cents per Pound	Cents per Pound
Prime Lake	13.25	13.00—13.25
Electrolytic	13.12½—13.25	13.00—13.12½
Casting	12.37½	12.00—12.25
Wire base	15.00—15.25	15.00—15.25
Lead, trust price	4.75	4.50
Antimony	5.20	5.12½
Nickel, Ingot	41.00	41.00
Sheet zinc, f.o.b. smelter	10.00	10.00
Zinc, spot	5.00	4.95
Tin	29.50	29.37½
Aluminum, 98 to 99 per cent	28.00	28.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	10.75—11.00	10.00—10.50
Brass, heavy	5.25— 5.50	5.00— 5.25
Brass, light	4.00— 4.50	4.50— 4.75
Lead, heavy	4.25— 4.50	3.75— 3.90
Zinc, old scrap	2.50— 2.75	2.50— 2.75

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

CERTAIN price changes have figured in the past week's transactions, although business activities seem to have settled down to a quiet summer trend. Manufacturers of schedule material have generally reduced some list prices and increased their discounts so that a general lower revision of about 10 per cent has resulted. Bells and buzzers are off about 20 per cent and non-renewable fuses are lower. The conduit and armored-conductor markets are soft. Licensees have been notified of a lower price on heating appliances effective July 15. The trade has been awaiting these reductions, and therefore they are not surprising.

Building of residences is progressing nicely in the New York, Atlanta, Intermountain and southern California territories. In New England it is not particularly active. The construction tie-up in Chicago appears to be broken up. Otherwise the demand for electrical materials is little better than a week ago. Manufacturers in St. Louis seem to be producing better, the agricultural outlook in the South and in California is favorable, and in the Northwest lumber is moving very satisfactorily.

NEW YORK

Prices are quite generally off this week but an increase in buying has not been reported. A general drop on the whole line of schedule material on June 11 is an important current feature of trade. Long-leaf yellow pine cross-arms are 10 per cent lower.

In addition to these two cuts bells and buzzers were reduced 20 per cent last week, and non-renewable fuses since the first of the month are down 11 to 16 per cent. Conduit is weak, an additional 5 per cent discount having been issued by manufacturers the first of this month, and the New York base price of armored cable, though nominally $55, is now $50 in reality. A slight break in washing-machine prices in one quarter is noted.

The fan-motor business in this section has been disappointing to date. Jobbers continue to buy conservatively in all lines, many holding not more than a thirty-day stock. The building outlook shows a great improvement in the period of May 21 to 27 inclusive over the previous week. According to the Dodge reports, plans for 832 new projects totaling $29,629,400 were reported in that period in New York State and northern New Jersey. New contracts awarded in that time, 451 operations valued at $13,529,600, also represent a big increase.

Conduit.—Good stocks are held, but demand is spotty. Prices are soft, an additional 5 per cent discount having been issued by manufacturers the first of the month without changing their card numbers. This is the second drop of this nature.

Conduletes, V. V. Fittings, Etc.—Demand is slow and stocks fair. The general discount allowed on this class of goods is 15 per cent in standard package lots.

Bells and Buzzers.—Following a cut in price of 20 per cent last week, several manufacturers state that they are meeting this reduction, though one producer reports that no change in price has been made.

Schedule Material.—Following the general price reduction of all manufacturers announced elsewhere in this issue, some jobbers state that they will replenish stocks which ran low anticipating the drop. Others say that demand does not justify stocking.

Flexible Armored Conductor.—Though the nominal base price is still $55 New York, the actual base is now $50 for single and double strip material. The latter in 1,000-ft. quantities, No. 14, sells for $55 and slightly below, but demand is quiet.

Fans.—Some business was reported the first of this week as the result of warm weather, but it was not general and sales on the whole have been unsatisfactory thus far with no real life in the demand. Prices quoted to dealers by different jobbers on three well-known makes, 16-in. oscillator, lots of twelve, are $28.50, $31.60 and $32.40 each.

Household Appliances.—Demand for washing machines, vacuum cleaners, ironers, etc., is very slow, and stocks are held down in line with the market. The only price change reported is on some sizes of one popular make of washing machine, which was reduced 5 per cent the first of the month.

Rubber-Covered Wire.—Stocks are good, but not so demand. The market is highly competitive, and most jobbers are quoting within 25 cents either way of $6.75 per 1,000 ft. for No. 14 single-braid in 10,000-ft. lots.

CHICAGO

Following the acceptance of the post of labor arbitrator by Judge K. M. Landis, the six-weeks-long tie-up of the construction industry in Chicago is at an end. Arbitration has finally been agreed upon, the lockout to cease at once. All operations are to be resumed at the old wage scale pending the decision of Judge Landis, and his decision is to be absolutely binding to both sides.

General business conditions during the past week have shown practically no change. Lack of interest is evident on all sides. Only that portion of the electrical industry having to do with the supply of the routine requirements is keeping busy. Demand from industrial users is at a minimum, and price is virtually no factor in demand under present conditions.

Jobbers and manufacturers should feel an immediate benefit from the settlement of Chicago's labor troubles as contractors and dealers have all allowed their stocks to get very low. The revival in building which it is felt is bound to result should at once make a demand for all classes of material used in the construction industry. Full stocks are in the hand of jobbers.

Wire.—Small movement is reported in all classes of wire, with prices firmly held. No. 8 bare copper at 17 cents per pound in 1,000-lb. lots is being ordered only for necessary maintenance. Rubber-covered is still quoted at $7 per 1,000 ft. for No. 14 in 10,000-ft. lots and weatherproof at 18½ cents per pound, for No. 6 triple-braid in 1,000-lb. quantities.

Conduit.—Sale of conduit to fill country demand, while brisk, is not sufficient to make good business. One-half-inch black is $59 per 1,000 ft.

Flexible Armored Conductor.—Prices are unchanged, with No. 14, two-wire, double-strip at $57.50 per 1,000 ft.

Cross-Arms.—As mentioned last week, new prices are in effect on long-leaf yellow-pine cross-arms. The price to jobbers from Chicago warehouse is now, for the 75 per cent heart, unpainted, 5-ft., four-pin size, $56.53 per 100; for the 6-ft., six-pin size, $67.83 per 100. Demand is limited to maintenance requirements.

Insulators.—Demand is slight and prices seem reasonable. Porcelain insulators, 5,000-volt, are quoted by one jobber at $21.25 per 100 in barrel lots and $34 in less quantity. The 6,600-volt size are $30 and $48 in similar quantities. Glass insulators, of which plentiful supplies are now available, are quoted at $95 per 1,000 for the 5,000-volt size.

Fuses.—Trade requirements on domestic sizes remain normal, but industrial sizes are moving slowly. "Economy" fuses have recently been cut 26.8 per cent in price, the present list being only 20 per cent above that prevailing in pre-war days. List on the 3-amp. to 30-amp. sizes is 50 cents; on 31-amp. to 60-amp. $1.

BOSTON

Substantial reductions in the prices of wiring supplies featured the closing portion of last week's market in New England. Schedule material was chiefly affected, and the jobbers are busy putting new resale prices into their quotation books. Reductions of 15 to 20 per cent were announced on fast-moving items and about 8 per cent on slow-moving material. Business continues to reflect a slow but definite movement toward greater confidence and increased activity. One of the leading jobbers reports a larger number of orders last week than for many months, and inquiries are better as well. Collections, while slow, are no worse than for some time. Jobbers' stocks are still equal to the current demand. Improved conditions are evident in the textile and shoe-manufacturing fields. The metal trades are still quiet, and building operations do not indicate very active conditions, although some improvement is evident. The liquidation of retail stocks and labor continues slowly.

Wire.—Moderate quantities are moving and stocks are plentiful. No. 14 rubber-covered is selling down to $6.25 per 1,000 ft. in 25,000-ft. lots. Weatherproof base is 16.5 cents and bare base about 15.5 cents, with light demand.

Sockets.—Improved demand is expected following new prices anounced by leading jobbers. In a representative make, key sockets are selling for 25 cents each in standard packages, keyless at 23 cents and pulls at 37.5 cents.

Fuses.—Fuses are quoted about 20 per cent off last week's earlier prices. While the demand is moderate, buying is better in spots. From 60 amp. at 250 volts and smaller 50 per cent off list is given on standard packages. N. E. C. plug-fuse cases are now selling at doubled list prices, with a discount on standard packages of 57½ per cent.

Cut-outs.—List prices of code cut-outs, slate and porcelain, and of 2,500-volt cut-outs have been doubled, and the following discounts are in vogue: Porcelain, standard package, 60 per cent; slate, standard package, 65 per cent.

Flexible Armored Conductor.—Moderate sales are being handled, and local stocks are excellent. No. 14 two-wire sells for $57 per 1,000 ft. in 1,000-ft. to 2,500-ft. lots, and above this open prices prevail. Fittings and couplings sell for 33⅓ per cent off double-manufacturing lists in less than standard packages and connectors at $7.50 per 100 in these quantities.

Fans.—Notwithstanding continued seasonable weather, fan movement is very slow. Carry-over stocks have by no means been sold out as yet. The next two or three weeks should give a correct "line" upon the 1921 fan season.

Dry Cells.—Flash battery sales are picking up. The demand for dry cells for general service is fairly good. One jobber reports 300 per cent increase in business in the past two months. In barrel lots, No. 6 cells are moving at $30.35 per 100.

Lamps.—Manufacturing for stock continues, one large plant running four days per week. Sign lighting is more active than most lines. Replacement orders are, of course, a stabilizing influence in the lamp market regardless of outside conditions. Portables are in some favor this month for wedding presents.

ST. LOUIS

No striking developments occurred during the week, yet some progress is being made toward normal conditions. Demand is gradually increasing and prices are lowering. Most of the manufacturers are increasing their production, and the general basis of production is probably about 40 per cent as compared with about 5 or 10 per cent the first of the year. The iron and steel industries are apparently the hardest hit, most of the plants being entirely closed down. The recent announcement that the Illinois Central Railroad will expend the money saved from the reduced wages in deferred maintenance work is considered as indicative of improvement in demand from the railroads. Automobile production is on a basis of about 25 per cent, furniture factories 35 per cent, planing mills 35 per cent, brick plants 50 per cent, and shoe factories 80 per cent. About all of the industrials are either planning or making plant changes for improved efficiency.

The sale of new power shows slight improvement and the kilowatt-hour sales continue to be the same or slightly greater than a year ago. Retail sales of appliances continue on a good basis. Motors and industrial wiring devices show but small demand. Jobbers still report a steady and slowly increasing business. The heavy call for fans existing a week ago fell off somewhat during the past week because of cooler weather.

Credit conditions are possibly somewhat better, yet the average basis for collections remains at from forty-five to sixty days. Indications are that the agricultural results this year will be good and this will tend to improve credit conditions in the electrical industry.

Fans.—Jobbers report a decreased call last week due to the cool weather, but in anticipation of large retail buying shortly there was nevertheless a good quantity of attractive orders. Jobbers' stocks as a rule are in line for the demand so far developed.

Lamp Cord.—Demand on local jobbers shows no improvement and most jobbers have stocks that are still a trifle heavy. No. 18 twisted cotton cord sells at $16.50 per 1,000 ft. in 5,000-ft. lots and No. 18 twisted silk at $23.

Wire.—One jobber reports slightly improved demand, particularly in the smaller sizes of rubber-covered. No. 14 rubber-covered, in 5,000-ft. lots, is selling around $6.75 per 1,000 ft. The base on bare copper and weatherproof is between 15 and 16 cents.

Meters.—Several jobbers report a continued increase in demand, particularly from the smaller outlying utilities. Prices are firm and stocks in excellent condition.

Motors.—Slight improvement in demand is found, and yet it is very slow. The principal call is for motors of 5 hp. to 25 hp. Stocks of fractional-horsepower motors are still considered too large. However, one manufacturer of motors up to 2 hp. reports a good business.

Bake Ovens.—Considerable interest is being manifested by a number of the bakers, but no sales have been made for some time. The price of industrial gas has recently almost doubled, thus making electrical baking more interesting.

Vitreous Enamel Furnaces.—Unusual interest is found among the local enamel concerns because of the excellent results being obtained from one local installation. In fact, considerable attention is being given to all forms of industrial heating equipment owing to special efforts on the part of the principal central-station company. Several large jobs are pending at the present time.

ATLANTA

Jobbers report their business for the past week as having shown little change from that of previous weeks. Orders, however, continue to come in slightly increasing volume, though the size of orders remains below the average, purchases being made for current demand only. On a canvass of the trade the more optimistic seem to feel that the month of July will show considerable improvement in their line, but the consensus of opinion, however, is that conditions will continue as at present until early fall. Trade in the small towns and rural districts continues to be sluggish, though the outlook for fall business in the argircultural districts is very good. The Georgia State Agriculture Department statistician, in conjunction with the federal Bureau of Crops' estimates, reports that in a majority of instances, cotton excepted, the condition percentage of general crops in the State is much better than the past ten-year average. If anything like this condition is maintained until harvest, it is felt that business in the rural districts will show great improvement, despite the comparatively small price which will be obtained for the products. This is due largely to the low cost of production as compared with selling prices.

The demand for homes continues and construction of small residences and apartments still shows healthy activity.

Rigid Conduit.—Jobbers report a fair movement, particularly in sizes up to 2-inch, both galvanized and black. Stock is good to fair, and shipments are excellent. Prices, lots less than 2,500 ft. black, ½-in. $84; 1-in., $161.30; 1½-in., $216, and 2-in., $351 per 1,000 ft.

Non-Metallic Flexible Conduit.—This market continues dull, orders being for very small amounts and for immediate demands only. All jobbers report heavy stock.

Flexible Armored Conductor.—A price reduction of 10 per cent is recently reported. Sales continue fairly good, though demand has slumped somewhat during the past several weeks. Jobbers expect a small price advance within the next ten days. Stocks vary from light to medium. Prices, two-wire, No. 14, lots of 1,000 ft. to 2,500 ft., $68 per 1,000 ft.

Safety Switches.—The market continues brisk, jobbers pushing safety switches in preference to the open type. In the case of the latter stocks are moving almost not at all.

Knobs, Tubes, Cleats.—With the exception of "Nail-it" knobs, the price of which is reduced 10 per cent, no reductions are expected before July 1. A slow but steady movement of the entire line is reported by jobbers who have heavy stocks on hand. Prices, standard packages, "Nail-it" knobs, $2.80 per 100; ⅝-in. x 4-in. tubes, unglazed, $1.23 per 100; combination one-piece rosettes, $8.50 per 100.

Lamp Cord.—The usual steady demand continues and stocks are reported in good shape.

Bell-Ringing Transformers.—Contractors are buying up to 50 per cent of their normal amount, but jobbers have allowed their stocks to sink to a low ebb.

Pole-Line Material.—Poles, cross-arms and hardware sales have not come up to early expectations. Little or no new construction is under way, purchases being confined largely to maintenance work, but the trade looks for better movement within the next sixty days. There is little activity in porcelain insulators, but the movement of glass telephone insulators is reported very good.

SAN FRANCISCO

On June 13, the builders' exchanges of San Francisco and the bay cities announced that they would open up building operations again on the American or open-shop plan, paying the wages recommended by the mutually selected board of arbitration, which are 7 per cent below the former schedule. Just prior to this date, the Building Trades Council announced that it had reconsidered its previous vote not to accept the above decrease and would return to work accordingly. However, the contractors of the builders' exchanges stand firm in their determination to employ labor irrespective of union affiliations. So far little building is reported.

The question of a bridge to connect San Francisco with Oakland, across the bay, is being vigorously advocated. No definite steps have yet been taken to start actual work, but there is no doubt that eventually the bridge will be built. The case is somewhat parallel to that of New York and New Jersey and presents similar problems, obstacles and benefits. All hope of the construction of the proposed thirty-million-dollar naval base at Alameda, on San Francisco Bay, has been abandoned, the measure having been killed primarily by the disarmament agitation.

Warm weather and almost ideal rainfall conditions are ripening the state crops and a big year is expected. Last year the action of the fruit associations in holding out for higher prices than the packers were willing to pay resulted in a very considerable loss to the growers, but this year amicable adjustments are expected.

Various conditions such as the building strike have interfered with the convention programs of the jobbers and contractors of the Pacific Coast and the state. The Pacific Coast Jobbers' Association has just met in San Francisco, but the California State Contractors' convention at Santa Cruz, originally set for the middle of June, has been indefinitely postponed.

Sales on electrical roughing-in material and other staples have fallen off tremendously in northern California, while in southern California such sales are very good. House-specialties such as washers and vacuum cleaners are in general slow throughout the state.

SEATTLE—PORTLAND

Electrical jobbers and dealers in the Northwest report little if any improvement in electrical trade over the past several weeks. The movement of domestic appliances and schedule materials, while below last year's levels, is fairly satisfactory, but sales of apparatus, including motors, generators, pole-line equipment, etc., are very much lighter than anticipated. Contractor-dealers are figuring on a considerable volume of work which is very slowly materializing. There are plenty of building plans under preparation, but contracts for building construction of consequence are not being awarded so rapidly as had been expected. Industrials generally are operating at low capacity, and proposed enlargements and extensions to existing plants are not being made.

No improvement is noted in collections, and very few new credits are being asked for or extended. Farmers in eastern Oregon and Washington are disposing of their wheat in considerable quantities, although the price they are receiving is less than the amounts which the banks have loaned upon the crops in general. Nevertheless, this should have a tendency to relieve the financial situation somewhat. The lumber industry appears more optimistic, mills are shipping more lumber than they are cutting, and new orders are in excess of shipments. Production in the Northwest mills is given as between 28 and 32 per cent below normal. Throughout certain parts of Washington and Oregon the fruit crop is reported rather unfavorable and the canning situation is very uncertain at the present time because of lack of orders for future delivery and difficulties confronting canners in financing their institutions.

Frozen credits in wool and farm crops are largely responsible for business inactivity. In Portland a reduction in price has been announced of about 10 per cent on ranges. Fans are beginning to show small movement in anticipation of summer weather.

Inside Wiring Material.—Business is a trifle better on account of numerous rewire and repair jobs which are under way. Prices are unchanged, although an early drop would not be unexpected. Stocks are good.

Flashlights.—The usual vacation run of sales is well started and jobbers anticipate a movement comparable to last year's. Stocks are in good shape and prices steady.

Washing Machines.—Dealers report a continued and steady interest in washing equipment, but owing to the general employment situation sales have not developed to the extent indicated by the inquiries. Stocks are in good shape and prices show no change.

SALT LAKE CITY—DENVER

Cooking schools at which electrical cooking appliances are demonstrated to thousands of women are being promoted during the month of June in several intermountain cities. Every electrical device for convenience and comfort in the home is shown in actual process of operation. The big response to these gatherings indicates wide interest among women in electrical appliances generally, and manufacturers and jobbers are using them as a means of popularizing their respective lines.

Home building in the city centers is proceeding on a rather satisfactory scale. There is little labor trouble to impede the progress of construction, and prices on building materials seem to have come down to a level that encourages more or less building activity. Big activity, however, is still waiting on the advent of better times. Slight improvement is noted in the matter of collections. Deliveries are good and electrical stocks in excellent shape generally.

Fans.—The fan market has experienced something of a flurry with the sudden advent of hot weather. With the mercury hovering around the 100-deg. point for the last week, a considerable demand has arisen. Stocks are reported sufficient to meet all requirements. The types most in demand are the 12-in. and the 16-in.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

New Kiln Capacity for Whitman Electric

The Whitman Electric Manufacturing Company, Whitman, Mass., has completed two new kilns of its own with large Sagar capacity. The company is getting out a line of porcelain specialties—rosettes, receptacles, etc.—and is in a position to make shipments on special porcelain material.

Big Increase in Space by Adapti Company

The Adapti Company, Cleveland, announces that it has purchased outright the property and buildings formerly occupied by the Cleveland Refrigerator Company at East Seventy-second Street and Oakwood Avenue, Cleveland, where operations will begin about July 15.

The new factory will give the company four times the manufacturing space it has at present, while the adjacent vacant ground included in the purchase will permit of liberal future expansion.

Household Electric Exposition for Chicago in October

The first annual Food and Household Appliance Exposition will be held at the Coliseum in Chicago, Oct. 1 to 10, according to an announcement of the Food and Household Appliance Exposition, Chicago *Herald and Examiner*, Hearst Building, Chicago. Every phase of home life will be covered, it is said, and 100 prominent women's organizations have already enlisted in the work of the show. Model kitchens, marketing booths, dining rooms, etc., will be shown with appliances and demonstrations, and it is understood that many manufacturers and jobbers have already signed up for space.

Diamond Electric's Two Plans for Increasing Sales

For building up sales of electrical appliances during 1921 the Diamond Electric Specialties Corporation, Newark, N. J., which believes that electrical appliances of every kind will be sold in greater quantities during 1921 than during any previous year, has formulated two plans which it is expected will help dealers increase their sales.

Plan number one is built on the sale of small specialties, such as flashlights, batteries, fans and socket heating devices. From recent investigations conducted by the Diamond company it was found that 74 per cent of the women had electric flatirons, 59 per cent had vacuum cleaners, 18 per cent washing machines, 4 per cent electric ironing machines, 22 per cent fans, 12 per cent electric percolators, 2 per cent electric stoves, 3 per cent vibrators and 30 per cent flashlights, etc. While these figures applied to a certain local market, they may not apply to another local market, so the company is urging its dealers to make a market analysis of their own trading communities as a basis for intensive sales work.

The second plan is built on the sale of washing machines, ironing machines, dish washers and vacuum cleaners. The basis of it is concentration upon tried and tested machines of the four lines with an appeal to the man of the family based on the saving and labor that will be effected in his household.

Increased Line for American Metal Molding Company

The American Metal Molding Company, Newark, N. J., is now producing a full line of conduit elbows in addition to its flexible armored conductor and metallic flexible conduit. Sufficient factory capacity also is available to turn out special press work for the commercial trade.

Reorganization of Kelvinator Corporation

Following the recent reorganization of the Kelvinator Corporation, 2051 Fort Street West, Detroit, manufacturer of iceless household refrigerators, announcement is made that there will be no change in the policy of the company and that it intends to continue the standard of its product. Service to its patrons will continue in the future as in the past—a matter of first consideration. The officers of the company are: A. H. Goss, president; U. R. Loranger, vice-president and general manager; H. W. Bailey, secretary; S. H. Todd, treasurer; C. A. Benford, sales director, and G. W. Dwelley, sales manager.

Successful Heat Show in New York Edison Rooms

During the week of June 6 to June 11 the New York Edison Company showrooms at Irving Place and Fifteenth Streets, New York City, were given over to an "electric heat show." Apparatus and appliances on exhibition and demonstration were for domestic use and industrial use, but at the same time there were interesting displays of materials and parts going into the make-up of this apparatus. The hours were from nine in the morning till six in the evening.

Thirty-eight manufacturers and representatives took part, and reports from the exhibitors showed the success of the undertaking. While many sales were recorded, it was the volume of inquiries received and leads obtained which satisfied the representatives. Far-distant points were represented in the inquiries noted. Furthermore, the degree of co-operation among the exhibitors was marked, and it is expected that the spirit that was manifested there will make itself felt in the upbuilding of this branch of the industry.

S. A. Woods Machine Company Extends Motor Line

The S. A. Woods Machine Company, Boston, has extended its line of motors to and including 25-hp. and 1,800 r.p.m. rating. This line of motors was recently brought out to introduce to the trade a class of equipment embodying interesting and advanced methods of ventilation and lubrication, the Woods company having organized a motor department at its South Boston shops and prepared to manufacture this product there. M. J. Fitch, sales manager, recently informed the ELECTRICAL WORLD that the company has already obtained orders for the complete equipment of several good-sized plants and that the indications are that business will soon increase still more rapidly.

McKenney & Waterbury Increase Distribution Activities

The McKenney & Waterbury Company, Inc., Boston, Mass., has been appointed distributers for the Phoenix Glass Company, Pittsburgh, and will market shades to dealers henceforth in barrel lots on application. This house has also become a distributer for the "Easy" washer. M. W. Vye, vice-president, reports a gradual improvement in jobbing sales within the past few weeks.

Freeman Electric Upheld in Socket Shell Decision

In the Supreme Court of the United States Justice Clarke on June 6 delivered the opinion of the court in a suit for infringement of patent No. 743,206, granted to August Weber, Sr., on writ of certiorari to the United States Circuit Court of Appeals for the third circuit—Weber Electric Company, petitioner, vs. E. H. Freeman Electric Company. The District Court held claims 1 and 4 valid and infringed, but the Circuit Court of Appeals, while affirming the validity of the claims, reversed the holding that they were infringed.

The opinion concludes that the socket of the respondent does not infringe the fourth claim of the patent in suit because there is no claim made therein of a lock against rotative movement of the cap and sleeve upon each other, etc., and the decree of the Circuit Court of Appeals as to claims 1 and 4 is affirmed.

Clark-Hunter Making Duwell Motor Grinders

The Clark-Hunter Company, Inc., 161 Summer Street, Boston, is now manufacturing the Duwell motor driven bench grinders at its Worcester factory. The company is also considering a few additions to its line which it hopes to put on the market soon.

Power Specialty Company Enlarging Its Works

The Power Specialty Company, manufacturer of Foster superheaters, economizers, oil stills, etc., 111 Broadway, New York, is just completing the expenditure of about half a million dollars in the enlarging of its works at Dansville, N. Y. This work includes a new steam-power plant and a new forge shop.

American Electric Fusion Plans Move to Larger Quarters

Preparations are being made by the American Electric Fusion Corporation, manufacturer of electrical apparatus for heating, welding and fusing, to move into more spacious quarters. The company has been manufacturing at 1906 North Halsted Street, Chicago, a temporary location, since last September.

Electrical Hotel Kitchen Products by L. Barth & Son

L. Barth & Son, 32 Cooper Square, New York City, has gone into the production of hotel and restaurant electrical kitchen equipment—bake ovens, ranges, broilers, hot plates, toasters, urns, plate warmers, etc.—and part of its factory at Kingston, N. Y., has been given over to this work. R. B. Basham, formerly of Duparquet, Huot & Moneuse, New York City, is manager of this electrical department.

Machinery Center Established in New York City

The Manufacturers' Exhibition Company, Inc., has been organized and has taken space in the old Greenhut Building on Sixth Avenue between Eighteenth and Nineteenth Streets, New York City. At present the entire second floor, containing about 85,000 sq.ft., is available for manufacturers who wish to make use of a central space for main offices, district offices, salesrooms or exhibition rooms for machinery and mechanical appliances. The third floor can be made immediately available for use, while the entire building is at the disposal of the company. In addition, there is about 47,000 sq.ft. of storage space at hand for keeping stocks, etc.

It is the purpose of the operating company to divide the exhibition space into sections, two of which are for power-plant equipment and for electrical apparatus. Already several manufacturers have taken space, and in the exhibits may be found lamps, gas-engine-driven generators and power-plant precision-measuring instruments. L. R. Duffield, formerly in charge of the machinery exhibit in the Grand Central Palace, New York, is in charge.

Service Department Opened in Detroit by Westinghouse

The Westinghouse Electric & Manufacturing Company has announced the opening of its service department and repair shop at 1535 Sixth Street, Detroit. It is a five-story building and similar to the sixteen buildings erected in the principal industrial centers of the United States for repair purposes.

The new repair shop is equipped to handle the designing and manufacture of all types of switchboards in the same way as they would be handled at the main works, and in addition dipping tanks and baking ovens are available. Stocks of repair parts are carried. The company's engineering organization, it is stated, is prepared to install or repair electrical or steam apparatus on the owner's premises.

John P. Morrissey, Inc., Formed in New York

A new company of contracting electrical engineers has been formed by John P. Morrissey in the National City Building, Forty-second Street and Madison Avenue, New York City, under the name John P. Morrissey, Inc. A request has been issued for catalogs covering electrical equipment for use in construction work.

Brinton-Hinley Electric Opens at Murray, Utah

A new electrical firm to be known as the Brinton-Hinley Electric Company has been organized by D. B. Brinton and George A. Hinley and will be established at Murray, Utah. This company will take over the electrical supply business of the Progress Company. Mr. Brinton has had wide association with the people of this locality and for twelve years has been closely affiliated with the Progress Company. Mr. Hinley, formerly of Ogden, has been engaged in electrical work for a great many years. Prior to his connection with the Progress Company he was employed by the Utah Power & Light Company. Besides electrical merchandising the company will make a specialty of electrical contracting, wiring and repairs.

Hotpoint-Hughes Ranges on Net Price Basis

In putting out its new line of Hotpoint-Hughes ranges with interchangeable sheath wire units and open coil units, the Edison Electric Appliance Company, Inc., 5600 West Taylor Street, Chicago, has just announced a new policy on prices. On electric ranges the company has discontinued quoting list prices and discounts and in place of this has adopted a principle of net prices to the trade. The percentage of margin of profit to its jobbers is stated to be the same as before. New lists are out showing jobbers' net prices and central station and dealer net prices, all effective June 15. As soon as the change can be effected the company announces that it will ship units separate from frames so that with a minimum number of frames and a complete stock of units customer requirements can be met by ready assembly.

Work Started Again on Johns-Manville Asbestos Plant

Johns-Manville, Inc., New York City, will proceed with the work of constructing and equipping its new plant at Waukegan, Ill., which was started more than a year ago. The total cost is estimated at $6,000,000 and about 360 acres are involved. Only certain buildings will be completed this year, however, such buildings as are necessary in the manufacture of asbestos products except textile.

The Emerson Electric Manufacturing Company, St. Louis, has reached an agreement with its employees whereby a wage reduction of 10 per cent will be effective from June 6. It is reported that this reduction is applicable to all classes of employees in the organization.

The General Electric Company is moving its production of certain schedule materials from Schenectady to its plant in Bridgeport, Conn. This will not be complete till next month.

The Crane Company, 636 South Michigan Avenue, Chicago, manufacturer of pipe, fittings, steam specialties, etc., has taken bids for its proposed new plant at Thirty-fourth Street and Allegheny Valley Railroad, Pittsburg. The cost with equipment is estimated at $800,000 and will include a six-story and basement pipe and pipe bending shop, 192 ft. x 292 ft.

The Pacent Electric Company, 150 Nassau Street, New York City, dealer in wireless instruments, has filed notice of increase in capital stock from $15,000 to $35,000.

The Power Specialty Company, 111 Broadway, New York City, manufacturer of superheaters, has filed notice of increase in capital stock from $270,000 to $950,000.

The Home Electric Appliance Company, 208 Stanwix Street, Pittsburg, has filed notice of increase in capital stock from $250,000 to $500,000.

The New Departure Manufacturing Company, Bristol, Conn., announces the removal of its Chicago sales office from 2721 South Michigan Avenue to the Peoples Gas Building, 122 South Michigan Avenue.

The Jeannin Electric Company, 110 Eleventh Avenue, Toledo, has purchased a site at Fassett Street and the New York Central tracks on which it proposes to erect a new factory. The capital stock of the company will be increased from $150,000 to $200,000 to provide for expansion of its business. The company manufacturers electric motors.

Foreign Trade Notes

THE ELECTRIC FURNACE CONSTRUCTION COMPANY, Philadelphia, and its Swedish associates have granted the exclusive rights and licenses for Brazil for the Gronwall type "Electrometall" electric shaft smelting furnace to the Companhia Electrometallurgica Brazillera and the Batcheller-McConnel Company, New York City. Two large furnaces each of 3,000-kw. capacity are being installed by he Brazilian company and it is expected that others will follow.

THE GEORGE C. ROUGH SALES CORPORATION, 134 Coristine Building, Montreal, Canada, has been appointed Canadian representative for the Duncan Electric Manufacturing Company, Lafayette, Ind., manufacturer of the Duncan meters. The company is also sales representative for the Volta Manufacturing Company, Ltd., Welland, Ontario, for the Montreal district.

THE LACHAPPELLE ENGINEERING COMPANY, Regd., successor to J. D. Lachappelle, has removed from 223 Notre Dame Street West to 414 St. James Street, Montreal, where it has opened an office and factory. The company handles the products of the Erie Electrical Equipment Company, Johnstown, Pa.

DEMAND FOR GAS-FILLED LAMPS IN CHINA.—According to reports there is an active demand in China for gas-filled lamps, the present supply being mostly of American or Dutch manufacture. In view of the fact that in cities like Hongkong, Shanghai and Canton the shopkeepers are making great efforts in illumination there is an extensive range of action for enterprising salesmen.

ELECTRIFICATION OF PAULISTA (BRAZIL) RAILWAY.—The initial order, it is understood, has been placed in the United States by the American contractors for the electrification of the Paulista (Brazil) Railway from the Jundiahy to the Campinas section, a distance of 45 km. The equipment includes two passenger locomotives of 2,000 hp. each and two freight engines of 1,500 hp. each. An overhead trolley at 3,000 volts continuous current will supply the power. The entire electrification when completed will cover about 160 km.

ENGLISH ELECTRIC COMPANY'S PROGRESS IN 1920.—From the address of the chairman of the English Electric Company, Coventry, England, before the annual meeting of the company held April 27, it was brought out that during the last year the company's principal task was that of consolidating its organization. Satisfactory progress was made in the adaptation of its Coventry works and the restoration of the other factories to their normal activities, and the company has proceeded with the least possible delay in the application of its fixed policy of devoting each factory to the manufacture of that class of machinery for which, by reason of its layout and past history, it is best adapted. At Coventry the company is manufacturing turbine units of very large size, rolling-mill equipment and the larger classes of engineering products. The Preston works are specializing still more highly in the production of electric locomotives and all forms of electrical traction equipment. At Rugby and Stafford the manufacture respectively of the medium sizes of steam turbines and electrical generating and industrial machinery has been further developed. The Bradford works, which have been especially laid out for the smaller range of industrial motors, have now their own machine molding foundry in addition. The company has been able to enlarge and improve the foundry capacity of its own works and thus to become to a greater extent independent of outside suppliers. Business both at home and abroad was well maintained up to the latter months of the year. The company still had a considerable order book to be executed when the report was made and, except in the smaller classes of its manufacture, it expects that it will have some big orders to carry over until trade revives. The company's working agreement with Siemens Brothers & Company, Ltd., has been followed by the formation of the English Electric & Siemens Supplies, Ltd. This company will deal exclusively with marketing the minor products of the new concern and electrical supplies generally. It has taken over the former subsidiary company, the English Electric Supplies, Ltd., together with a section of the selling organization of Messrs. Siemens.

THE CANADIAN JOHNS-MANVILLE COMPANY, Ltd., with sales offices at Montreal and Toronto, and which for a number of years has been operating asbestos properties at Asbestos, Quebec, has awarded contracts for the construction of a plant in Asbestos. All classes of asbestos product formerly imported from United States will be manufactured in the new plant.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An inquiry has been received from a business man in England (No. 34,984) for an ice-making plant of a capacity of about 5 or 10 tons per day.

The representative of a group of manufacturers in China (No. 34,983) is in the United States and desires to form direct connections with manufacturers of machinery for electric power plants, transmission equipment, telephone equipment, etc. Catalogs, price lists and full information are requested.

A commercial agency in Spain (No. 34,994) desires to secure the representation of manufacturers for the sale of electric automobiles.

The industrial representative in the United States of a European country (No. 34,999) desires to secure catalogs and quotations from manufacturers of electrical machinery, apparatus, supplies and insulating materials, machine tools, transportation equipment and labor-saving devices.

LARGE HYDRO-ELECTRIC PROJECT FOR FORMOSA.—Consul Henry B. Hitchcock, Taihoku, Taiwan, Formosa, has forwarded to the Bureau of Foreign and Domestic Commerce, Department of Commerce, a copy of the specifications and drawings for the mechanical and electrical equipment of the Jitsugetsutan (Lake Candidius) hydro-electric project to be constructed by the Taiwan Electric Power Company, which has been forwarded to the bureau's New York Office, 734 Custom House. Reference should be made to file No. 29,632.

New Apparatus and Publications

ARC WELDING.—"Electric Arc Cutting and Welding by Alternating Current" is the title of a new fifty-two-page publication of the Electric Arc Cutting & Welding Company, Newark, N. J.

LABORATORY RESISTANCE BOXES.—The Ward Leonard Electric Company, Mount Vernon, N. Y., has developed a line of laboratory resistance boxes using "Vitrohm" tubes in sizes from 10 ohms to 1,000,000 ohms.

BELT CONVEYOR IDLER.—The C. W. Hunt Engineering Corporation, 143 Liberty Street, New York City, is distributing a folder describing its new all-steel self-aligning belt-conveyor idler.

ELECTRIC DRILL. — The Louisville Electric Manufacturing Company, Louisville, is distributing a circular covering its No. 3, two-speed, and No. 2, single-speed "Universal" electric drills.

BENCH GRINDER.—The Clark-Hunter Company, Inc., 161 Summer Street, Boston, is distributing a four-page leaflet describing the "Duwell" motor-driven bench grinder.

ELECTRIC WELDERS.—Bulletin No. 1 issued by the American Electric Fusion Corporation, 1906 North Halsted Street, Chicago, describes its type "VW" vertical welders.

AUTO-TRANSFORMER STARTERS. — The Cutler-Hammer Manufacturing Company, Milwaukee, is distributing an eight-page folder describing the C-H 9141 auto-transformer starter.

ELEVATOR CONTROLLER. — Publication 2035 issued by the Cutler-Hammer Manufacturing Company, Milwaukee, describes the C-H elevator controllers.

MAGNETIC CLUTCH.—Publication 2030 covers the Magnetic Clutches of the Cutler-Hammer Manufacturing Company, Milwaukee.

KVA. METER.—A graphic kva. meter has been developed by the Esterline-Angus Company, Indianapolis.

ALTERNATING CURRENT OHM-METER.—The Esterline-Angus Company, Indianapolis, has brought out a graphic alternating current ohm-meter for recording the resistance of liquids, the concentration of solutions, etc.

STEAM SEPARATORS.—The Griscom-Russell Company, 90 West Street, New York City, is distributing bulletin No. 1140, describing its Stratton receiver-type separator and other Stratton steam separators.

SMALL GENERATING SETS.—Bulletin No. 1117, recently issued by the Allis-Chalmers Manufacturing Company, Milwaukee, covers its small generating sets, which are suitable for isolated lighting and power plants, shipboard service, etc.

DAMPER REGULATOR. — The Atlas Valve Company, 282 South Street, Newark, N. J., has issued bulletin No. 5 describing its Victor damper regulator, No. 3, high-pressure.

New Incorporations

JOSEPH E. GREENE, INC., Boston, Mass., has been incorporated with a capital of $350,000 to manufacture electrical equipment and supplies. The directors of the company are Joseph E. Greene, 111 Federal Street, president and treasurer; L. A. Greene and D. F. Cunningham.

THE HAPPY HOME MANUFACTURING COMPANY, LTD., Toronto, Ont., has been incorporated with a capital stock of $40,000 to manufacture hand, gas, electric and water-power machines, wringers, etc. The incorporators are Daniel A. Lee, 32 Barrington Avenue; George S. Winder, 167 Kingswood Road; Frank F. Frendt and others.

THE BUFFALO SMOKE PREVENTION CORPORATION, Buffalo, N. Y., has been incorporated by C. E. Hock, W. A. Wilson and C. H. Cutting, 49 Niagara Street. The company is capitalized at $100,000 and proposes to manufacture fuel-saving and smoke prevention equipment for power-plant service.

THE WANAKENA LIGHT & POWER CORPORATION, Fine, N. Y., has been incorporated with a capital stock of $10,000 by J. F. Dubar, J. O. Hamele and F. M. Duryea.

THE ELECTRIC SUN COMPANY, Philadelphia, Pa., has been incorporated with a capital stock of $50,000 to manufacture electrically operated outdoor displays. A. V. R. Barringer, Jr., 1705 Mount Vernon Street, is treasurer.

THE W. H. HESS ELECTRIC COMPANY, Oneida, N. Y., has been organized by W. H. Hess and M. M. Dunn, Oneida, to manufacture electrical machinery and parts.

TINDALL & WHITE, INC., New York, N. Y., has been incorporated by C. A. White, 291 Broadway, and others. The company is capitalized at $100,000 and proposes to manufacture electrical appliances, lamps, etc.

THE ACME ELECTRIC COMPANY, INC., Baltimore, Md., has been incorporated with a capital stock of $10,000 to manufacture electrical specialties. The incorporators are Clarence D. Boyle, Louis Storm and L. Malloy, 223 North Calvert Street.

THE RIDGEFIELD (WASH.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $17,000. The incorporators are N. C. Hall, J. W. Blackburn, W. E. Lentz and W. S. Miller.

THE SHIRLEY (ILL.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $25,000 by Charles W. Hutchinson, Charles Zeig, Deloss Funk, J. P. Walters and C. Welch.

THE SALEM (KY.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $3,500 by T. M. George, J. V. Hayden and L. Hayden.

THE MOOSE RIVER POWER COMPANY, Lyons Falls, N. Y., has been incorporated with a capital stock of $10,000 to operate a local electric plant and system. The incorporators are F. DeP. Hone, C. W. Tillinghast and C. L. J. Ager. The company is represented by Porter & Taylor, 30 Broad Street, New York City.

(Issued May 17, 1921)

1,374,960. COLLAPSIBLE TOOL BAG FOR LINEMEN. Emanuel F. Shipman, Philadelphia, Pa. App. filed April 17, 1920. For hoisting tools, insulators, etc. No metal parts.

1,378,554. TROLLEY; George B. Nussbaum, New Philadelphia, Ohio. App. filed Dec. 1, 1920. Will follow curvatures.

1,378,557. ELECTRICAL SYSTEM; Ernest W. Pragst, Schenectady, N. Y. App. filed July 30, 1920. For suppressing grounds.

1,375,564. COLLECTOR-RING SUPPORT; Theodore Schou and Richard L. Behrens, Mansfield, Ohio. App. filed July 14, 1920. For rotary fields.

1,378,565. BRUSH HOLDER; Theodore Schou, Mansfield, Ohio. App. filed July 14, 1920. Tandem type.

1,378,566. ELECTRIC COOKER; Jacob L. Shroyer, Oak Park, Ill. App. filed Sept. 19, 1919. Vegetable cooker.

1,378,585. TELEPHONE SYSTEM; Elmer Curnutt, Garnett, Kan. App. filed Aug. 14, 1917. Rural party line.

1,378,589. ELECTRIC SADIRON; Leo B. Lincoln, Chicago, Ill. App. filed July 11, 1919. Easy access to heating element.

1,378,599. PROCESS AND APPARATUS FOR MAKING ELECTRODES; William G. Michel, Niagara Falls, N. Y. App. filed Dec. 17, 1919. By passing current.

1,378,604. CONDENSATION-PREVENTING DEVICE; John W. Murphy, Cambridge, Mass. App. filed June 17, 1920. For windows, windshields, etc.

1,378,684. ELECTRIC HEATING APPARATUS; Frank P. Kobert, Amityville, N. Y. App. filed June 5, 1920. For metal-working machines.

1,378,695. CONTACT SHOE; Henry G. Lewis and Walter S. Mayer, Philadelphia, Pa. App. filed Nov. 20, 1918. Rail contact.

1,378,708. MICROPHONE; Ray H. Manson, Rochester, N. Y. App. filed June 23, 1917.

1,378,712. AMPLIFIER; Joseph W. Milnor, New York, N. Y. App. filed Jan. 17, 1916. for telegraphic signals.

1,378,740. AUTOGUBERNATOR; Samuel T. Walkup, New York, N. Y. App. filed July 30, 1917. Self-guiding means for torpedoes, etc.

1,378,761. ELECTRICAL BOILER; Leonard R. Brunswick, Superior, Wis. App. filed Sept. 22, 1920. Heating plant for house.

1,378,801. ELECTRIC CABLE TAP; Homer M. Lamb, West Frankfort, Ill. App. filed Aug. 9, 1920. For "gathering motors" in mines.

1,378,829. APPARATUS FOR THE ELECTROLYSIS OF SOLUTIONS OF ALKALINE CHLORIDES; Claus N. Rilber, Trondhjem, Norway. App. filed Dec. 12, 1918. Has horizontal diaphragms.

(Issued May 24, 1921)

1,378,836. BALANCING EQUIPMENT FOR FOUR-WIRE CIRCUITS; Alva B. Clark, Brooklyn, N. Y. App. filed Jan. 29, 1919. Operator may monitor, talk and ring on circuits which include repeater circuit.

1,378,839. SIGNAL FOR DINING TABLES; Nathaniel B. Cregier, Los Angeles, Cal. App. filed July 11, 1916. Ornamental waiter signal.

1,378,850. ELECTRICALLY HEATED APPLIANCE; Lindol French, East Pepperell, Mass. App. filed July 18, 1919. To prevent overheating.

1,378,884. COINCIDENT MAXIMUM-DEMAND RELAY; Erving A. Lueky and Roy N. Houghton, Detroit, Mich. App. filed April 7, 1920. Automatically recording power supplied through a number of meters.

1,378,888. GALVANIZING MACHINE; Constantine G. Miller, Chicago, Ill. App. filed March 19, 1920. For galvanizing automobile rims, belly bands, tire carriers, etc.

1,378,919. PORTABLE REPEATER APPARATUS; John F. Toomey, New York, N. Y. App. filed March 22, 1919. Mounted in portable box.

1,378,923. SUPPORT FOR BRUSH HOLDERS; Walter J. Warder, Jr., Chicago, Ill. App. filed Jan. 17, 1918. Heavy-current generators.

1,378,938. TELEPHONE-EXCHANGE SYSTEM; Henry P. Clausen, Mount Vernon, N. Y. App. filed Sept. 25, 1916. Improved signaling.

1,378,940. AMPLIFIER FOR TELEPHONIC TRANSMITTERS; Harry T. Dale, New York, N. Y. App. filed March 31, 1919.

1,378,943. SELECTIVE SIGNALING SYSTEM; Joseph C. Field, Orange, N. J. App. filed April 24, 1917. Telephone.

Record of Electrical Patents

Notes on United States Patents

1,378,947. MACHINE-SWITCHING TELEPHONE SYSTEM; Charles L. Goodrun, New York, N. Y. App. filed July 14, 1917. Line-finder switches.

1,378,950. RECORDING KEY; Augustus D. Hargan, Bayonne, N. J. App. filed Dec. 4, 1918. Telephone.

1,378,952. ELECTRICAL CONNECTION; Ellsworth A. Hawthorne, Bridgeport, Conn. App. filed April 4, 1918. Dry-battery connector.

1,378,969. METHOD OF MANUFACTURING INDUCTANCE COILS; Ivan L. Milton, East Orange, N. J. App. filed March 22, 1920. Manufacturing cores.

1,378,971. ELECTRIC REGULATOR; William E. Moore, Pittsburgh, Pa. App. filed Nov. 16, 1918. For furnace, prime mover, etc.

1,378,972. ELECTRIC FURNACE; William E. Moore, Milwaukee, Wis. App. filed July 18, 1919. Non-ferrous.

1,378,978. TELEGRAPH SYSTEM; Paul M. Rainey, Glen Ridge, N. J. App. filed June 22, 1917. Printing telegraph.

1,378,982. SIGNALING SYSTEM; Herbert E. Shreeve, Millburn, N. J. App. filed Sept. 17, 1918. Combined wire and radio.

1,378,990. SIGNALING DEVICE; James A. Wotton, Montclair, N. J. App. filed June 13, 1918. Telephone plug.

1,378,991. TROLLEY-POLE HEAD; George T. Bell, Boston, Mass. App. filed Aug. 9, 1919. Easily replaced on wire.

1,379,017. SEMI-AUTOMATIC TELEPHONE SYSTEM; George A. Yanochowski, Chicago, Ill. App. filed Feb. 21, 1916. Busy call.

1,379,026. HAIR-WAVING HEATER; Frank and Gabriel Lantieri, Newark, N. J. App. filed Nov. 26, 1919.

1,379,037. TROLLEY-POLE HEAD; Howard F. Norman, Newtonville, Mass. App. filed April 16, 1920. Wheel automatically replaced.

1,379,068. MEASURED-SERVICE TELEPHONE SYSTEM; John Wicks, Chicago, Ill. App. filed Feb. 12, 1919.

1,379,088. STORAGE BATTERY; Thomas A. Edison, West Orange, N. J. App. filed Sept. 16, 1919. Alkaline.

1,379,089. PRODUCTION OF THIN METALLIC SHEETS OR FOILS; Thomas A. Edison, West Orange, N. J. App. filed Oct. 4, 1919. Nickel flakes for storage batteries.

1,379,144. CUT-IN SYSTEM OF RADIO-TELEGRAPHY; Paul Ware, New York, N. Y. App. filed Feb. 8, 1918. Enabling receiving station to cut in on sending station.

1,379,166. RADIANT-ENERGY SIGNALING SYSTEM; Theodore W. Case, Scipio, N. Y. App. filed Jan. 22, 1918. Transforms light rays into audible signals.

1,379,167. WIRELESS RECEIVER; Theodore W. Case, Scipio, N. Y. App. filed Feb. 20, 1918. For detecting feeble currents.

1,379,172. PHOTOMETRIC DEVICE; Virgil C. Crites, Chicago, Ill. App. filed Jan. 9, 1920. Photo-electric cell.

1,379,184. SHIELDING RADIO APPARATUS; Louis A. Hazeltine, Hoboken, N. J. App. filed Nov. 1, 1917. For eliminating disturbing effects caused by movements of the human body.

1,379,237. DETINNING OF TINNED IRON SCRAP; Matthew A. Adam, London, England. App. filed Aug. 31, 1920. Recovery of tin from tinned iron.

1,379,243. TELEGRAPH SYSTEM; John H. Bell, South Orange, N. J. App. filed Jan. 3, 1918. Submarine.

1,379,244. ELECTRICAL CONNECTOR DEVICE; Reuben B. Berjamin and Albert V. Boetter, Chicago, Ill. App. filed May 4, 1918. Plurality of receptacles supplied from a single outlet.

1,379,262. RADIO-RECEIVING ANTENNA; Stanton C. Hooper and George H. Clark Washington, D. C. App. filed Sept. 16, 1919. Multiple-antenna system.

1,379,266. COMPENSATION METHOD AND APPARATUS; Earl A. Keeler, Norristown, Pa. App. filed May 5, 1920. Measuring resistivity of materials.

1,379,279. LAMP; Ralph Osborn, Randolph, Neb. App. filed May 29, 1919. Small dry-battery lamp.

1,379,287. TELEPHONE INSTRUMENT; Frank J. Reichmann and John Press, Chicago, Ill. App. filed June 21, 1918. Loud-speaking receiver.

1,379,342. TIME-CONTROLLED DESK MEMORANDUM; Joseph A. Howell, Dover, Ohio. App. filed Dec. 13, 1920.

1,379,356. ELECTRICALLY HEATED COAT; Antonangelo Negromanti, Milan, Italy. App. filed April 4, 1919.

1,379,366. PROCESS OF PRODUCING ELECTRICAL CONDUCTORS; Ralph L. Seabury, Toledo, Ohio. App. filed March 17, 1919. Commutator brushes.

1,379,405. DYNAMO-ELECTRIC MACHINE AND SYSTEM OF CONTROL THEREFOR; Rudolf E. Hellmund and Laurence M. Perkins, Swissvale, Pa. App. filed Nov. 16, 1917. Single-phase commutator motor.

1,379,406. DYNAMO-ELECTRIC MACHINE AND SYSTEM OF CONTROL THEREFOR; Rudolf E. Hellmund, Swissvale, Pa. App. filed Nov. 19, 1917. Single-phase commutator motor.

1,379,413. MAGNETO; Edward A. New, Great Barrington, Mass. App. filed Nov. 28, 1919. For blasting.

1,379,467. ELECTROLYTIC CELL; Howard W. Matheson and Frederick T. Kaelin, Shawinigan Falls, Quebec, Can. App. filed April 15, 1918. For oxidizing mercury.

1,379,479. AUTOMATIC LIGHTING DEVICE FOR GAS STOVES; Walter E. Schneider, Pryor, Okla. App. filed July 6, 1920.

1,379,481. INCASED ELECTRICAL APPARATUS; Ivanhoe H. Sclater, Pittsfield, Mass. App. filed June 25, 1920. Transformer.

1,379,523. PROCESS OF REDUCING ALUMINUM OXIDE; L. Burgess, New York, N. Y. App. filed Aug. 15, 1919. Arc furnace.

1,379,541. ELECTROMAGNETIC-WAVE NAVIGATIONAL ARRANGEMENT; James Erskine Murray and James Robinson, Biggin Hill, England. App. filed Oct. 29, 1919. Directive propagation.

1,379,546. APPARATUS FOR RAISING OR LOWERING A LOAD; Rudolf Forster, Essen, Germany. App. filed Sept. 4, 1920. Motor compensates weight of load at all speeds.

1,379,557. RECEIVER-HOOK SWITCH FOR PORTABLE TELEPHONES; John T. Gray, Great Falls, Mont. App. filed Aug. 13, 1919.

1,379,560. PROTECTIVE DEVICE FOR INCANDESCENT LAMPS; Cromwell A. B. Halvorson, Jr., Lynn, Mass. App. filed Oct. 26, 1916. On direct-current series circuits.

1,379,582. PROCESS FOR PROTECTION AGAINST ELECTROLYTIC DESTRUCTION; Franz von Wurstemberger, Zurich, Switzerland. App. filed July 23, 1920. For condensers, etc.

1,379,589. WIRELESS APPARATUS; Henry H. Hyder, Hollywood, Cal. App. filed June 5, 1918. For exploding mines.

(Issued May 31, 1921)

1,379,614. OVERHEAD-CARRIER SYSTEM; Earl T. Bennington, Colonial Heights, Ohio. App. filed Oct. 11, 1920. Monorail.

1,379,637. CARTRIDGE EXPLOSIVE; Edward S. McKinlay, Denver, Col. App. filed Jan. 16, 1917. For blasting.

1,379,650. TESTING APPARATUS FOR MESSAGE REGISTERS; William A. Rhodes, New York, N. Y. App. filed June 27, 1919. For telephone switchboard.

1,379,671. PERCOLATOR; Theodore Abtmeyer, Pittsburgh, Pa. App. filed March 28, 1913, andd Nov. 10, 1917. Thin annular column of liquid is isolated for heating.

1,379,686. ELECTRICAL SYSTEM; Edward A. Hanff, Irwin, Pa. App. filed Nov. 22, 1916. Generator and motor permanently connected in closed circuit.

1,379,693. CONTROL SYSTEM; Amos A. Ponsonby, Scranton, Pa. App. filed Aug. 9, 1920. For governing dynamo.

1,379,698. STANDARD CELL; Clarence J. Rottmann, Wilkinsburg, Pa. App. filed Sept. 13, 1919. Long life.

1,379,706. VACUUM-VALVE DETECTOR; Roy A. Weagant, Roselle, N. J. App. filed March 10, 1917. Not subject to disturbances.

1,379,721. IRONING IMPLEMENT; Harry A. Rapelye, Edgewood Park, Pa. App. filed Oct. 1, 1919. Contains filling compound.

1,379,767. SWITCH MECHANISM; Hubert F. Krants, Brooklyn, N. Y. App. filed Feb. 11, 1919. Inclosed switch may be mounted with others on panel.

1,379,776. OZONIZIER; Melvin J. Napier, Akron, Ohio. App. filed April 8, 1920.

1,379,795. SWIVEL CONNECTION FOR ELECTRICAL CONDUCTORS; Charles O. Allen, Shawnee, Okla. App. filed April 9, 1919. For telephones.

New England States

NORWAY, ME. — The Central Maine Power Company, Augusta, is considering changes to its local power house.

Middle Atlantic States

BINGHAMTON, N. Y.—The Binghamton Light, Heat & Power Company is considering the extension of its lines for light and power service in Whitney Point and Maine, N. Y.

BRASHER FALLS, N. Y.—The Milling & Lighting Company, Inc., has applied to the Public Service Commission for authority to erect a transmission line from its power plant to Nicholville, Lawrence County.

BUFFALO, N. Y.—The City Council has approved a contract for improvements to the street-lighting system on Genesee Street from Bailey Avenue to Jefferson Street.

ENDICOTT, N. Y. — The Binghamton Street Railway Company is considering the construction of a new electric power house in Endicott.

GEORGETOWN, N. Y.—The Georgetown Electric Lighting Company has applied to the Public Service Commission for authority to build and operate an electric lighting system in Georgetown. It is proposed to locate the plant in the Andrus feed mill, which will supply power to operate the system.

HERKIMER, N. Y.—The Municipal Commission of Herkimer is considering extensions to the lighting system to East Herkimer.

NYACK, N. Y.—The Rockland Light & Power Company has applied to the Public Service Commission for permission to issue bonds, the proceeds to be used for the construction of an addition to its power plant, including new steam and electric equipment, estimated to cost about $435,000.

WATERVLIET, N. Y.—The installation of an ornamental lighting system in the business district is under consideration.

JERSEY CITY, N. J.—The Rogers-Pyatt Shellac Company, 39 Essex Street, is considering the construction of a new one-story power house at its plant.

BERLINSVILLE, PA. — The Genuine Washington Slate Company has closed down its boiler plant and is purchasing power from the Pennsylvania Light & Power Company. The former company contemplates the installation of additional equipment to double the size of its plant.

PITTSBURGH, PA.—Merger of light and power companies in Armstrong, Clarion and Butler Counties with the West Penn Power Company has been authorized by the Public Service Commission.

BALTIMORE, MD. — The Standard Oil Company has prepared plans for a new one-story power house, 93 ft. x 143 ft. at its plant on Third Avenue, to cost about $50,000.

OXFORD, MD.—Arrangements are being made by the Council for an issue of $15,000 in bonds for improvements and extensions to the electric system.

FAIRMONT, W. VA.—The Forest Coal Company is considering the installation of new machinery at its properties, including considerable electrical equipment, to cost about $150,000. H. W. Showalter is president.

RICHMOND, VA.—The Common Council has appropriated $10,000 for improvements to the lighting system on Hull Street.

WASHINGTON, D. C.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing the following: Until June 21, Annapolis, Schedule 8,285—20,000 ft. two-conductor concentric cable; Portsmouth, Schedule 8,312—6,700 ft. electric cable and wire. Until June 24, Indian Head, Schedule 8,270—12,000 ft. electric cable; South Brooklyn, Schedule 8,272—miscellaneous quantity of switchboard panel material; Philadelphia, Schedule 8,307—three transformers, six fuse switches and one wattmeter.

North Central States

GRAND RAPIDS, MICH.—A movement has been started by the residents of Plainfield Avenue for the installation of an ornamental lighting system on that thoroughfare from Grove to Knapp Street, covering a distance of nine blocks. The cost is estimated at $15,000.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

CLEVELAND, OHIO.—The City Council has adopted resolutions providing for the installation of an ornamental lighting system on Superior Avenue from East Ninth Street to the boulevard, St. Clair Avenue from East Ninth Street to Gordon Park, Paine Avenue from the intersection of Superior Avenue to East Fifty-ninth Street, and on Euclid Avenue to University Circle.

HAMILTON, OHIO.—Plans and estimates will be prepared, it is understood, for the construction of a municipal electric light plant and remodeling the plant now in use.

CHICAGO, ILL.—The Old Ben Coal Company, 332 South Michigan Avenue, is considering the construction of a new power house, 50 ft. x 85 ft., at its No. 16 mine, to cost about $50,000.

QUINCY, ILL.—Extension to the street-lighting system on Sixth Street is under consideration. The cost is estimated at $20,000. L. L. Harper is engineer.

DES MOINES, IOWA.—Extensions to the lighting system from Fifth and Chestnut Streets to Thirteenth and Crocker Streets are under consideration. A. E. McGlothen is city clerk.

NEW VIRGINIA, IOWA.—The local electric light plant was recently destroyed by fire.

HOPE, N. D.—Bonds have been voted for improvements to the electric light plant.

KIOWA, KAN.—Plans are under consideration to erect a transmission line from Kiowa to Byron, Okla., also from here to Amorita, Okla. An election, it is understood, will be held to vote on the proposal to issue $30,000 in bonds for the project.

LAWRENCE, KAN. — Bids will be received by the State Board of Education, Topeka, until June 21 for a new two-story power plant at the University of Kansas, Lawrence. The cost is estimated at about $100,000.

HEBRON, NEB.—The construction of a hydro-electric plant on the Blue River near Hebron to cost about $25,000 is under consideration. W. Kassenbaurn is interested.

Southern States

MIAMI, FLA.—The Miami Light & Power Company is considering an expenditure of $275,000 for improvements, including the installation of machinery at its main plant to cost $200,000, additional boilers, $50,000; remodeling boiler house, $10,000; constructing meter repair shop, etc. H. H. Hyman is general manager.

NEW SMYRNA, FLA.—Business men of New Smyrna have started a movement for the installation of an ornamental lighting system on Canal Street, covering a distance of about a half-mile.

PLANT CITY, FLA.—The proposal to issue $150,000 in bonds to establish electric light and ice plants in Plant City is under consideration.

WAUCHULA, FLA.—J. G. Fancy and associates, Fort Mead, are considering the construction of an electric, ice and cold storage plant in Wauchula to cost about $50,000.

NEW ORLEANS, LA. — Preliminary plans are under way by the Consumers' Electric Light & Power Company for the construction of a new power plant.

COMANCHE, OKLA. — Bonds to the amount of $275,000 have been voted for improvements to the lighting, water and sewer system.

EL RENO, OKLA.—The Oklahoma Gas & Electric Company is considering rebuilding its lines at a cost of about $25,000.

TULSA, OKLA.—Cosden & Company are considering improvements and extensions to the power house at their local oil works to cost about $100,000. New equipment will be installed.

Pacific and Mountain States

OLYMPIA, WASH.—Estimates have been submitted by the Olympia Light & Power Company to the lighting committee of the Chamber of Commerce for lighting the main business district of the city with cluster lamps. The plans call for 310 standards, the cost not to exceed $50,000.

FULLERTON, CAL.—Property at Harvard and Walnut Streets, Fullerton, has been acquired by the Southern California Edison Company, Los Angeles, on which it will erect a new power house to cost about $50,000.

LOS ANGELES, CAL.—The Little Rock Power & Water Company has filed application with the State Water Commission for 50 cu.ft. per second direct diversion and 3,000 acre-ft. per annum, storage, from Little Rock Creek for power purposes. The total amount to be developed is estimated at 2,415.

OROVILLE, CAL.—L. O. Griffith has applied to the State Water Commission for 400 cu.ft. per second from the middle of Feather River and the south fork of Feather River, for power purposes. Diversion will be made by means of a conduit.

OROVILLE, CAL.—The Middle Feather River Development Company is having plans prepared and investigations made for the development of 185,000 hp. The plans provide for the construction of four power plants on the middle fork of the Feather River and a storage reservoir at Grizzly Valley to have a capacity of 90,000 acre-ft. Lars Jorgensen is engineer.

SAN FRANCISCO, CAL. — The United States Electric Steel Products Company, Inc., contemplates the construction of a new plant for the manufacture of steel products to cost more than $5,000,000. The plans provide for a power plant. The electric furnace installation will be made by the Electric Furnace Construction Company, 908 Chestnut Street, Philadelphia.

STOCKTON, CAL.—Application has been filed with the State Railroad Commission by the Western States Gas & Electric Company and its subsidiary, the El Dorado Power Company, for a certificate of convenience and necessity for construction work and extensions. The Western States Company proposes to enlarge its plant on the south fork of the American River, which, together with the proposed power plant of the El Dorado Power Company on the south fork of the Feather River, will give a total development of 156,000 hp. The latter company also plans to erect a transmission line to connect the two plants.

WILLOWS, CAL. — The Pacific Gas & Electric Company plans to install electroliers in Willows. The cost is estimated at about $8,000.

PHOENIX, ARIZ.—The Pacific Gas & Electric Company, it is reported, has applied to the corporation commission for permission to sell $500,000 in bonds. The proceeds are to be used to take up outstanding indebtedness and for improvements to its electric and gas systems.

PHOENIX, ARIZ.—The Southern California Edison Company, Los Angeles, Cal., has filed application with the State Water Commission to develop the water power of the Colorado River at Glen Canyon and Diamond Creek. The cost of the project is estimated between $625,000,000 and $800,000,000.

BASIN, MONT.—The Jib Mining Company contemplates the erection of a 300-ton concentrating mill which will require an additional motor capacity of about 750 hp., also the installation of an additional bank of 600-kva., 62,500-volt to 2,200-volt transformers. The company supplies the town of Basin with light and water service.

Canada

BRIDGEBURG, ONT.—Plans are being prepared by the Hydro-Electric Commission of Ontario for the construction of another canal parallel with the one now under construction. The new canal when completed will develop about 100,000 hp. and will cost about $10,000,000.

CHIPPAWA, ONT.—The Montrose substation on the end of the new canal of the Hydro-Electric Commission of Ontario was recently damaged by fire, causing a loss of about $100,000.

CEDAR, QUE. — The Montreal, Light, Heat & Power Company, 83 Craig Street, West, Montreal, has awarded the general contract for an addition to its power house at Cedar to cost about $80,000 to Anglin-Norcoss, Ltd., 65 Victoria Street, Montreal.